

ANTERIOR CINGULATE GYRUS HAS AN INHIBITORY ROLE IN THE MICTURITION REFLEX OF RATS

Hypothesis / aims of study

The micturition reflex is controlled by a complex hierarchy of the central nervous system. We previously reported that the anterior cingulate gyrus (ACG) is thought to participate in the control of micturition and urinary continence in rats. Additionally, ACG neurons could have an important role in micturition control based on animal physiological and human functional neuroimaging studies. Previous fMRI studies in healthy control subjects and those with confirmed overactivity also showed that infusion into the bladder is associated with enhanced responses in the ACG at large bladder volumes in urge-incontinent patients (Ref.1). However, there are only a few reports that examine the effects of direct intervention of ACG on bladder activity. The purpose of this study was therefore to examine how direct stimulation of ACC affects the micturition reflex using rats.

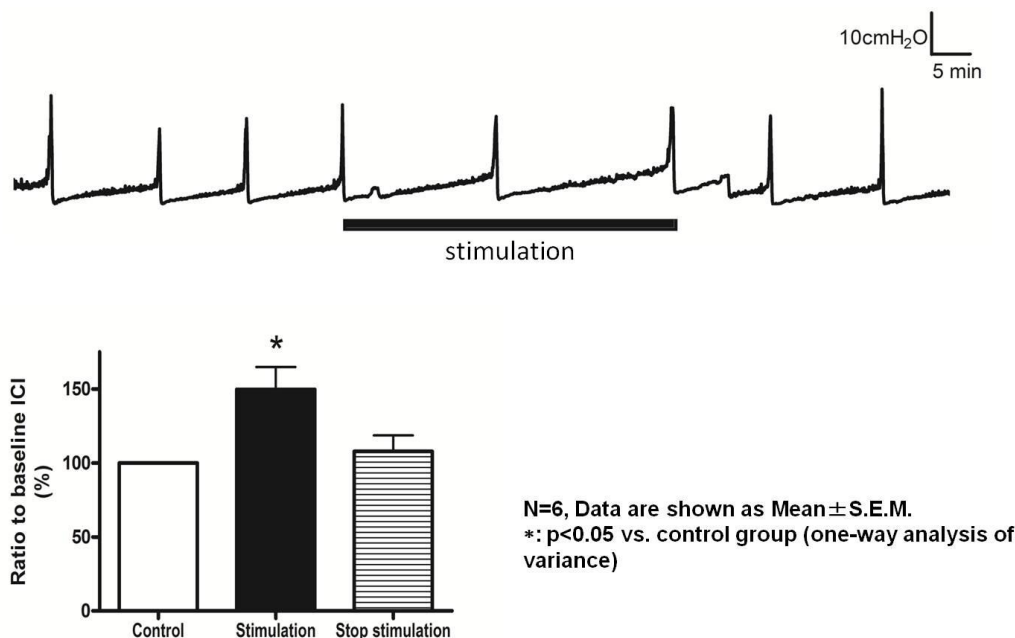
Study design, materials and methods

Female Sprague-Dawley rats were used. Animals were anesthetized with urethane and a tungsten electrode was inserted stereotaxically into the ACG (A: 3.2 mm, L: 0.6 mm, V: -1.8 mm from the bregma). The bladder was exposed through a midline abdominal incision, and a cannula (PE-50) was inserted into the bladder, and continuous cystometrograms were recorded. After obtaining baseline micturition reflex parameters, electrical stimulation (10V, 100Hz and 30ms duration) was applied to ACG for 30 minute through a tungsten electrode. Bladder function was evaluated by measuring intercontraction intervals (ICI) and maximal voiding pressure (MVP).

Results

Electrical stimulation of ACG significantly increased ICI without changing MVP from the baseline values (Figure). When stimulation was stopped, ICI immediately returned to baseline values. We also confirmed the reproducibility of ICI increases during ACG stimulation since repeated electrical stimulation of ACG with an interval of 30 min exhibited the similar inhibitory effects on ICI.

Effect of the anterior cingulate gyrus (ACG) electrical stimulation on intercontraction intervals (ICI) in urethane anesthetized rats



Interpretation of results

These results indicate that direct stimulation of ACG inhibits the micturition reflex. In previous clinical studies, neural activity in the ACG was significantly increased in the condition of overactive bladder (OAB). However, it is hard to determine that these changes are a cause or a result of OAB as we could not reliably evaluate this mechanism in human studies. This study suggests that an increase in ACG neural activity in OAB might be a defense mechanism to counteract bladder overactivity as ACG stimulation had an inhibitory effect on bladder activity. Moreover, ACG is a higher brain region that sends its projection to the pontine micturition center, which is a key brain region controlling the micturition reflex.

Concluding message

ACG is a potential candidate region to enhance the therapeutic inhibitory effects in the treatment of OAB.

References

1. Griffiths, D. and S. D. Tadic (2008). Bladder control, urgency, and urge incontinence: evidence from functional brain imaging. *NeuroUrol Urolyn* 27(6): 466-74.

Disclosures

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