Effects of Ovariectomy and Estrogen Replacement on Bladder Blood Flow and Bladder Function in Female Rats
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Introduction & Objective
Menopause and subsequent estrogen deficiency have been implicated in the etiology of overactive bladder (OAB) in elderly females. Recently, attention has focused on ischemia of the bladder as a common pathophysiological mechanism for lower urinary tract symptoms (LUTS), including OAB. In the present study, we investigated the effects of ovariectomy (OVX) and estrogen replacement on bladder blood flow (BBF) as well as on bladder function in female rats.

Methods
All experimental protocols were approved by the Institutional Animal Care and Use Committee of the University of Yamanashi (Chuo, Yamanashi, Japan) and University Nihon (Koriyama, Fukushima).

All experiments were performed by using Virgin Sprague-Dawley rats (24-week old).

Group 1: SHAM, Group 2: OVX, Group 3: OVX + Estrogen replacement (OVX+E)

Estrogen replacement; β-estradiol 1mg/kg/week s.c.

Four weeks after operation
BBF
Rats anesthetized with urethane and the anterior bladder was exposed.
A laser speckle blood flow imager (OMEGAWAVE, INC. Tokyo, Japan) was used to measure BBF.

Cystometric study in awaked rats
Three days before cystometry, rats were underwent catheter implantation.
The cystometric parameters:
- maximum pressure (MP),
- baseline pressure (BP),
- threshold pressure (TP),
- micturition interval (MI),
- bladder capacity (Bcap),
- micturition volume (MV),
- and post-void residual volume (PVR).

Table 1 – Cystometric parameters from 11 SHAM, 11 OVX, and 7 OVX+E rats.

<table>
<thead>
<tr>
<th></th>
<th>SHAM</th>
<th>OVX</th>
<th>OVX+E</th>
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<tbody>
<tr>
<td>MI</td>
<td>12.64 ± 0.0984</td>
<td>10.66 ± 0.0279</td>
<td>12.29 ± 0.072</td>
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<tr>
<td>Bcap</td>
<td>2.186 ± 0.1061</td>
<td>1.670 ± 0.0610</td>
<td>2.549 ± 0.0109</td>
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<tr>
<td>MV</td>
<td>2.064 ± 0.1010</td>
<td>1.636 ± 0.0891</td>
<td>1.904 ± 0.1082</td>
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<td>PVR</td>
<td>0.047 ± 0.01735</td>
<td>0.033 ± 0.00645</td>
<td>0.049 ± 0.00685</td>
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<td>Baseline pressure</td>
<td>13.4 ± 0.3671</td>
<td>14.29 ± 0.3384</td>
<td>13.65 ± 0.3095</td>
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<tr>
<td>Threshold pressure</td>
<td>30.09 ± 0.9493</td>
<td>30.26 ± 0.7066</td>
<td>29.70 ± 1.009</td>
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<tr>
<td>Maximum pressure</td>
<td>41.05 ± 1.467</td>
<td>38.01 ± 1.005</td>
<td>40.94 ± 1.346</td>
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Statistical analysis
All values were expressed as the mean ± SEM. Data were analyzed using the Prism program (GraphPad Software, Inc.).

Results
Fig 1 – Bladder blood flow measurements in 9 SHAM, 9 OVX, and 10 OVX+E rats. Double asterisks indicate p < 0.01 SHAM and OVX+E groups versus OVX group.

Fig 2 – Typical cystometrogram recordings in SHAM, OVX, and OVX+E groups. Scale bar represents 10min.

Conclusions
The present study showed that OVX reduced BBF (ischemia of the bladder) and induced bladder hyperactivity that was characterized by decreases in MI and Bcap. Estrogen replacement was shown to restore BBF and bladder function to normal. Since bladder ischemia is known to cause functional and structural alterations of the bladder, decreased BBF and consequent ischemia may play a potential role in the development of bladder hyperactivity in rats with estrogen deficiency.

Conflict of Interest Disclosure
I have no potential conflict of interest to report.