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ROLE OF THE URINARY BLADDER IN WATER METABOLISM—HOW DOES THE BLADDER ABSORB URINE?

Hypothesis / aims of study

The bladder is often perceived as a simple reservoir of urine that does not itself affect water metabolism. However, previous clinical reports suggested that the human bladder affects the secretion of arginine vasopressin (AVP) and absorbs urine[1]. Studies have suggested that the bladder absorbs water or solutions; for example, the bladder of rats absorbs saline.[2] Urea, sodium, potassium, and chloride move across rat urothelial cells[3], but the mechanism has not been elucidated. We investigated the potential role of aquaporins, which are expressed on the bladder urothelium and are involved in the transport of water and solutions. We hypothesized that: [1] filling of the bladder induces AVP secretion; [2] AVP, which makes aquaporin-2 to transport water, induces water absorption in the bladder; and [3] water absorption in the bladder is associated with solutes. The aim of the study was to investigate these hypotheses by performing rat experiments.

Study design, materials and methods

Female Sprague-Dawley rats weighing 300 g were used for the study to study the role of the bladder in water metabolism. In all rats, ureters were ligated bilaterally at the level of bifurcation of the abdominal aorta. The proximal urethra, into which the transurethral bladder catheter was inserted, was ligated to prevent leakage of intravesical fluid, and blood flow to the bladder was maintained.

[Exp. 1 (Fig. 1A)] In the full-filled bladder group, the bladder was filled with 1.0 mL of saline. In the control group, the bladder was empty. Serum AVP was measured over time (0, 30, 60 minutes), using an ELISA kit.

[Exp. 2 (Fig. 2A)] In the AVP group (AVP+), 4 μg/rat of DDAVP was intravenously administered. In the non-AVP group (AVP-), saline was administered. The bladder was filled with 1.0 mL saline for 3 hours and the intravesical fluid volume was measured.

[Exp. 3 (Fig. 3A)] The bladder was filled with 1.0 mL of saline or a 5% glucose solution for 3 hours. The intravesical fluid volume as well as the concentration and osmolarity of sodium and chloride were all measured.

Results

[Exp. 1] A full-filled bladder did not modify the serum AVP level (Fig. 1B, C).

[Exp. 2] Although the intravesical fluid volume and the sodium level significantly decreased over time, DDAVP administration did not affect the extent of the decrease (Fig. 2B).

[Exp. 3] The intravesical volume of saline significantly decreased more than that of the 5% glucose solution (Fig. 3B). In the saline group, the levels of sodium and chloride decreased (Fig. 3C, D). After 3 hours, the osmolarity was significantly higher in the glucose group compared with the saline group (Fig. 3E).

Interpretation of results

The urinary bladder absorbed water or solutions when it was fully filled. The extension of the bladder wall and absorption of the intravesical solution was not associated with serum AVP levels. Thus, our findings do not support either hypothesis [1] or [2]. Water effectively permeated the urothelium in the presence of small molecules. When a glucose solution was instilled in the bladder, only water permeated the urothelium, and glucose remained in the bladder, as glucose molecules were too large to permeate the urothelium.

Concluding message

The urinary bladder has an AVP-independent absorptive function associated with smaller solutes such as electrolytes.

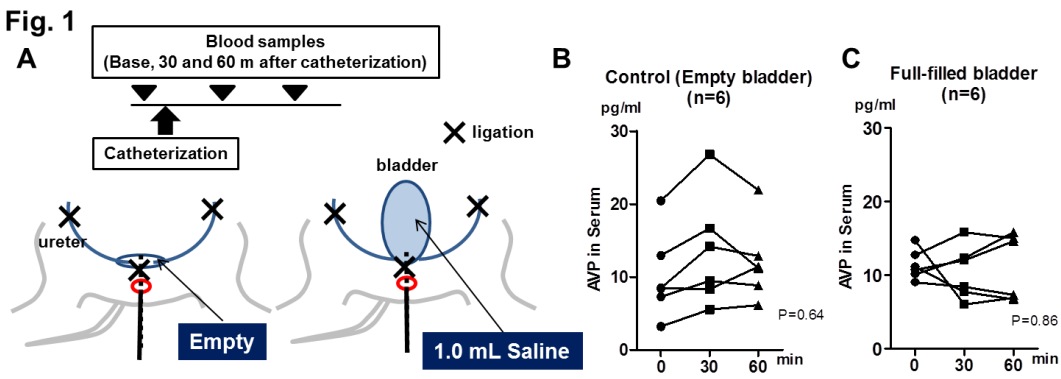


Fig. 2

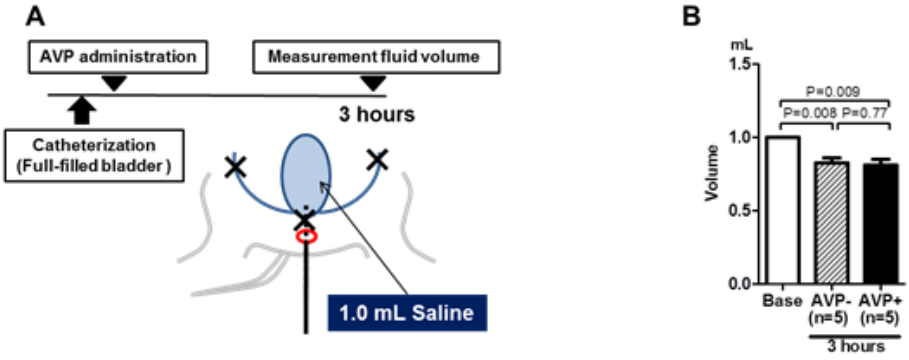
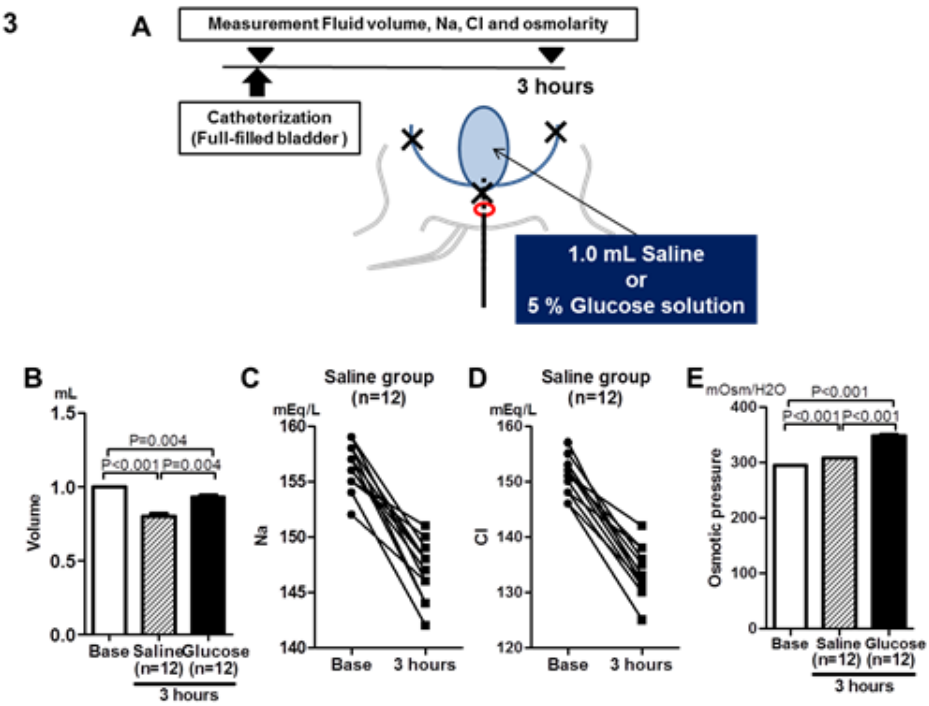


Fig. 3



References

1. Watanabe H, Azuma Y. Periodical measurement of urine volume in the bladder during sleep: Temporary volume reduction suggestive of absorption. Int J Urol. 2016;23(2):182-7.
2. Sugaya K, Ogawa Y, Nishizawa O, et al. Decrease in intravesical saline volume during isovolumetric cystometry in the rat. Neurourol Urodyn. 1997;16(2):125-32.
3. Spector DA, Deng J, Stewart KJ. Dietary protein affects urea transport across rat urothelia. Am J Physiol Renal Physiol. 2012;303(7):F944-53.

Disclosures

Funding: none **Clinical Trial:** No **Subjects:** ANIMAL **Species:** Rat **Ethics Committee:** The Guide for Care and Use of Laboratory Animals (National Research Council) and the animal facility committee at Nara Medical University (ID: 11326).