Aim of study

In humans the desire to void is influenced by urinary pH - the desire being experienced at lower bladder volumes when the urine is more acidic (1). Detrusor contractions can also be provoked in many patients by instillation of acidic solutions into the bladder (2). The working mechanisms for these effects remain to be clarified. The aim of the present experimental study in the rat was to modulate the micturition threshold by infusion of fluid at low pH and to identify associated changes in bladder afferent and efferent activity.

Methods

Thirteen female rats, anaesthetised by α-chloralose and paralysed by pancurone bromide, were used for the experiments. Micturition threshold volume was determined by repeated transurethral cystometries at low infusion speed (0.06 ml/min). Saline, titrated to pH 3, 4, 5, 6 and 7 by acetic acid, was used for infusions. Bladder afferent and efferent activity was recorded, simultaneously with cystometry, from exposed pelvic nerve branches to the bladder. After an initial equilibrium period, four control cystometries were performed with saline at pH 7. The different acidic solution were then tested in random order until at least 4 cystometries at each pH were obtained. A resting interval of at least 3 minutes, with the bladder open and empty, was interposed between successive cystometries.

Bladder pressure, afferent or efferent nerve activity together with the full-wave rectified and integrated nerve responses were continuously recorded on a HIOKI chart recorder and subsequently analysed off line with a PC based system. The following parameters were studied: afferent and efferent threshold volumes, micturition threshold volume and pressure, afferent activity at micturition threshold, peak afferent and efferent activity, bladder pressure at peak contraction, afferent pressure sensitivity. The used recording technique resolved primarily activity in myelinated Aδ afferents from bladder mechanoreceptors (3).

Results

A total of 509 cystometries were performed. There was a small gradual decrease in micturition threshold volume with acidic solutions from a mean volume 0.49 ml at pH 7 to 0.42 ml at pH 3. The change was only significant for the two lowest pH levels (pH 4 and 3; $p < 0.01$). At these low pH levels there was also a small decrease in mean bladder compliance (from 5.3 to 4.8 ml/ cm H2O; $p < 0.01$) and peak contraction pressure (from 41 to 39 cm H2O; $p < 0.5$). There was no detectable change in afferent or efferent pelvic nerve activity or in other measured parameters.

Conclusion

Cystometry with acidic solutions induced a significant decrease in the micturition threshold volume of anaesthetised rats. The decrease occurred without a detectable change in the firing properties of bladder Aδ mechanoreceptor afferents. It is proposed that proton sensitive bladder receptors with unmyelinated afferents were stimulated by the acidic solution and that the micturition reflex was facilitated by afferent inflow from such receptors.

Reference

(1) Neurourol Urodyn 16:396-397, 1997
(2) Neurourol Urodyn 9: 355-356, 1990
(3) Neurourol Urodyn 17:543-553, 1998

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**DETRUSOR STIFFNESS. NEW INSTRUMENTATION FOR THE *IN VITRO* THE EVALUATION OF BLADDER CONTRACTION.**

**AIMS OF STUDY.**

Current methods used in the evaluation of isometric bladder contraction involve the suspension of a strip of bladder into a chamber, tying one end of the tissue to a fixed point and the other to a force transducer. In the present study we introduce a new instrument for the measurement of bladder contraction obviating the need to tie the tissue. This instrument was used in the evaluation of bladder stiffness, produced by cholinergic stimulation of the rat bladder. The tissues used for these experiments were obtained from ovariectomized (OVX) and estrogen-treated (OVX+E) rats.

**METHODS.**

The stiffness biosensor was made up of a piezoelectric crystal (PZT) having 1mm in diameter and supported by a micromanipulator. The crystal was electrically driven at its resonance frequency by an oscillator. Upon contact with the tissue the resonance frequency of the PZT shifted in accord with tissue stiffness. This frequency shift, $\Delta f$, was calibrated to represent tissue stiffness in gm/cm.

Tissue segments, 50 mg in weight and approximately 5x5 $mm^2$ in size, were dissected from the bladder domes of 6 OVX and 6 OVX+E rats. The tissues were placed on a cotton gauze, soaked in Krebs solution, and placed under the biosensor so that three consecutive measurements could be taken. These initial measurements represent baseline stiffness. The response of the bladder was measured when high [K$^+$] and increasing doses of Carbachol 2,20,200 ng/kg were directly applied onto the surface of the tissues. Three measurements were taken after the addition of each dose. Dose response curves were generated for the stiffness of the OVX and OVX+E groups.

**RESULTS**

The results show that the biosensor was able to produce consistent and reliable measurements of bladder stiffness under control conditions. Figure 1 shows a dose response curve of the relationship of bladder stiffness to Carbachol concentration. As indicated stiffness is shown to increase significantly following the addition of Carbachol. The response to increasing doses of the stimulant was markedly different between the two groups of rats, indicating that the biosensor possesses sufficient sensitivity for detecting variations in tissue stiffness.