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A NOVEL FEMALE RAT MODEL FOR LOWER URINARY TRACT FUNCTION STUDIES

Aims of Study

To obtain information on the mechanisms of female rat micturition we designed a model in which pressure was measured in the bladder and distal part of the proximal urethra, i.e. on both sides of the rhabdosphincter (RB). This approach provides information on the action of the RB in opening and closing of the urethral lumen. Additional, supportive information was obtained by recording EMG of RB and measurement of flow from the distal urethra.

Methods

Adult (6 months) anaesthetized {chloral hydrate (0.9 g/kg)} female Noble strain rats weighing 250-280 g were used in the study. The bladder, anterior surface of the RB and distal urethra were exposed with a midline incision of the lower abdomen. Symphysis pubis bone was cut in vertical direction, in order to expose the RB. A 20 gauge i.v. infusion cannula was inserted through the bladder apex into the lumen for saline (0.9 % NaCl) infusion (0.185 ml/min) into the bladder and intravesical pressure (BP) (with a pressure transducer, Statham P23XL, Hato Ray, Puerto Rico) (1) measurements. Micturition was evoked by infusion of saline. A T-letter shape pressure probe (made from 20 gauge syringe needle) was placed at the distal part of the RB in urethral lumen for urethral pressure (UP) recording (with a pressure transducer, Statham P23XL, Hato Ray, Puerto Rico). An ultrasonic flow probe connected to a flowmeter (Transonic Systems, Inc. Ithaca, NY, USA), was used for measurement of the urine flow rate from the distal urethra (2). At the same time as the measurements of BP and UP, and flow rate, the EMG activity of the RB was measured extracellularly with a suction electrode (3). Schematic illustration of the positions of the probes is shown in figure 1.

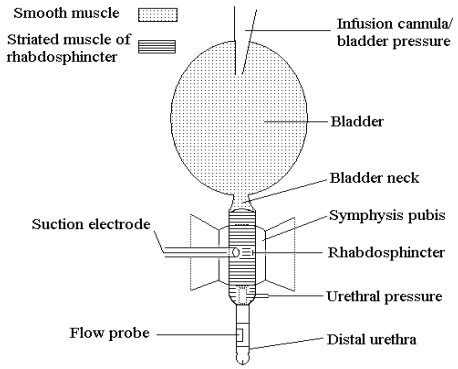

Figure 1. Schematic illustration of the positions of the probes.

Results

When the first phase of the non-oscillatory micturition contraction starts, BP increases and exceeds UP (figure 2, arrow). This is maintained during the whole micturition. Even though BP increases during the first phase, UP does not increase until the RB and thus urethral lumen opens. A sudden contraction of the RB prevents the spread of BP to the site of UP measurement. The RB acts as an on-off switch. When it is open (on-position) fluid starts to flow from the bladder to the urethra causing reduction of BP and the rise of UP. When the sphincter gets momentarily closed (off-position) the flow ceases, being otherwise on-going, leading to decline of UP. Figure 3 shows typical pressure changes of the BP and UP, EMG activity of the RB, and flow during the second oscillatory phase.

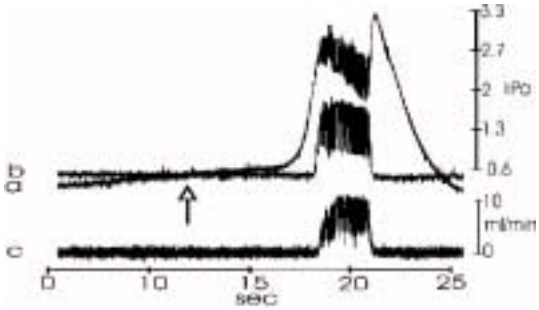

Figure 2. A measurement of bladder pressure (a), urethral pressure (b) and flow (c) in a female rat. Bladder pressure exceeds the UP when the micturition contraction starts (arrow) UP is not changing. Opening of the urinary sphincter is indicated by a sudden rise of UP.

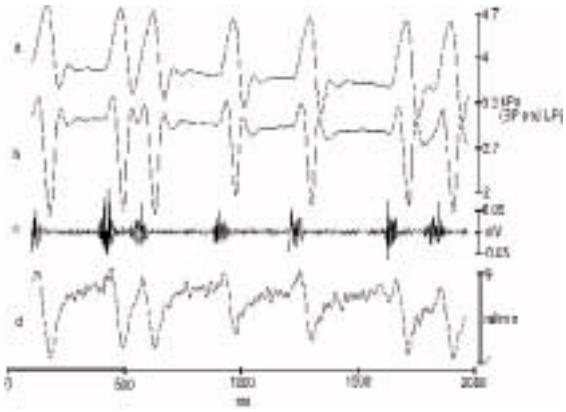

Figure 3. Typical recording of a) bladder pressure, b) urethral pressure (UP), and c) EMG recording of RB and d) flow rate. Pressures of bladder and urethra have the same zero level and magnification. EMG precedes the UP waves indicating closure of the urethral lumen, which is seen as a reduction of flow.

Conclusions

The simultaneous recording of the BP, UP, EMG of RB, and flow rate reveals the sequence of events during micturition. This animal model would allow a detailed studying of the drug effects on lower urinary tract function.

References

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