

URINARY FLOW, INTRAVESICAL PRESSURE AND SEQUENCE OF EVENTS DURING VOIDING IN AWAKE FEMALE RATS, AS OBSERVED BY SIMULTANEOUS RECORDING OF INTRAVESICAL AND INTRAURETHRAL PRESSURES

Hypothesis / aims of study

Four phases can be distinguished in female rat micturition, as measured by transvesical cystometry (Fig. 1). In anesthetized rats, it has been well proved that urinary flow starts at the initial point of the 2nd phase (IP2).¹ However, there still have been controversies on when the urinary flow starts and what relationships exist between specific points on intravesical pressure curve of the awake cystometry and real micturitional events.

The aims of this study were 1) to test the hypothesis that the flow starting point in awake rat cystometry is same as that found in the anesthetized rat, and 2) to obtain information on the sequence of events occurring during micturition in awake female rats, using a model in which the pressures were measured simultaneously in the bladder and distal part of the urethra.

Study design, materials and methods

The study was carried out in 6 female Sprague-Dawley rats undergoing urodynamic measurements (18 cycles assessed). Intravesical and urethral pressures were recorded in the bladder and distal urethra via open catheter technique. Micturition volume was recorded with a fluid collector connected to a force displacement transducer (Research Grade Isometric Transducer; Harvard Apparatus). A PE-50 catheter with an elongated end (diameter: less than PE-10) was inserted into the distal urethra. Cystometry was performed without anesthesia 3 days after insertion of the catheters (Fig. 2). The time difference from the initial point of 1st phase (IP1) to IP2, initial point of third phase (IP3), initial point of fourth phase (IP4), the urethral pressure rise point (UPRP), the point of urethral pressure decrease to original baseline (UPDP), and volume rise point (VRP) were recorded (Fig. 1).

Results

Using IP1 as a reference point, the times to IP2nd (2.31 ± 0.44 sec) and UPRP (2.30 ± 0.44) were the same. However, the times to IP2nd and VRP (4.20 ± 0.43) were different ($p < 0.001$). This suggests that urine flow begins at the IP2 and that the volume recording does not start to increase until 1.89 sec later. This time difference between IP2 and VRP showed an inverse relationship to total voided volume ($y = -0.148x + 1.377$, $R^2 = 0.028$). In 78 % of the voiding cycles, the urethral pressure returned to basal level before the 4th phase start (6.75 ± 0.38). The intraluminal high-frequency oscillation starts just after IP2 in IVP and UP, which showed an inverse relationship.

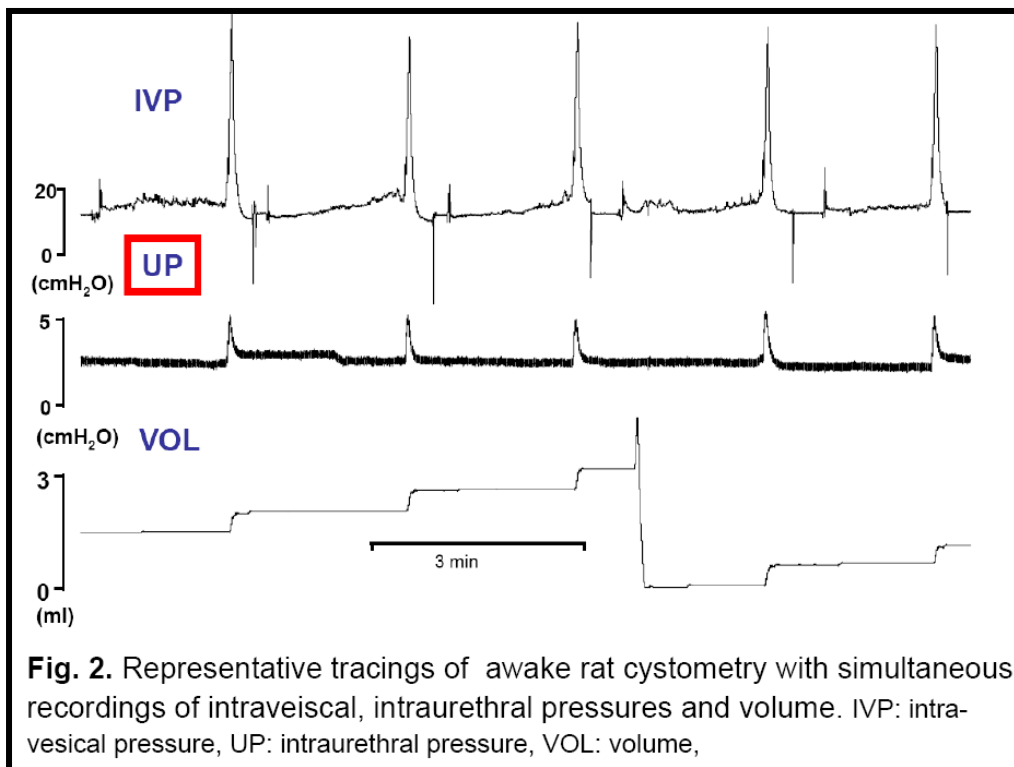
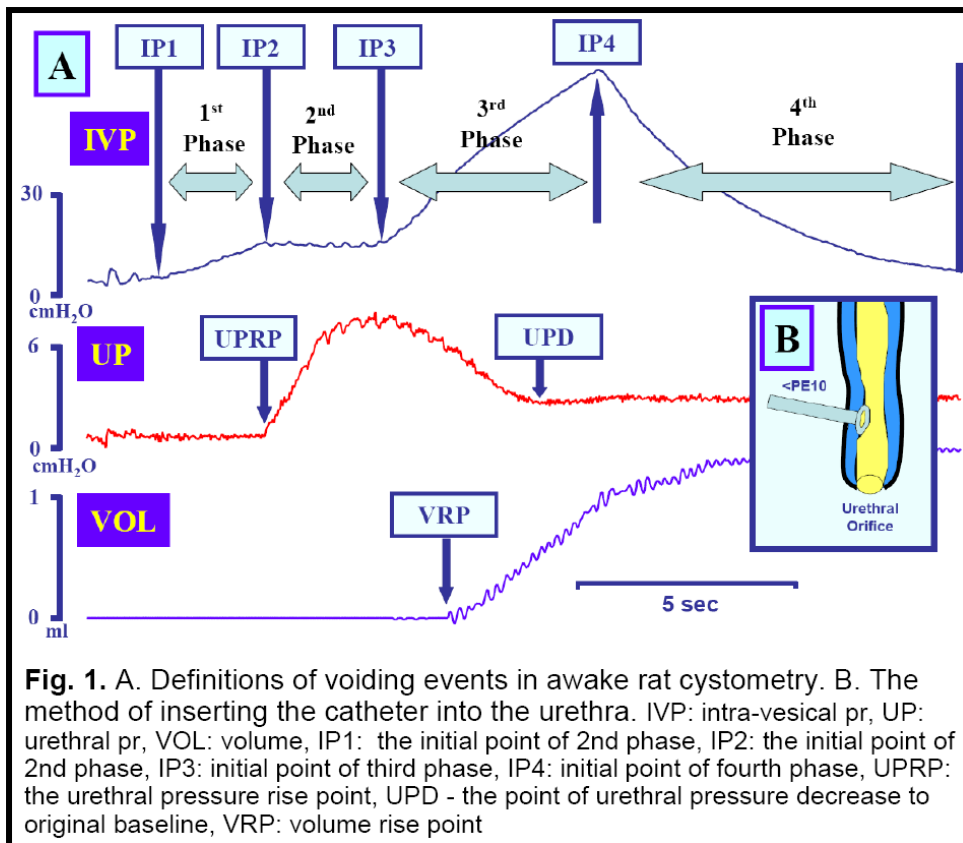
Interpretation of results

The awake rat starts urinary flow at the initial point of the 2nd phase, similar to the anesthetized rat. The timing of volume tracings in awake cystometry does not reflect the real start of urethral flow, which is caused by the distance between urethral orifice and fluid collector. According to the UP findings, urethral flow ends before 4th phase. Thus, the conventionally recorded micturition pressure, located in the middle of 4th phase, may not be real. This might be related to the pulling down effect from the fixed catheter tip, because the bladder dome goes down to the urethra on voiding.

Concluding message

The simultaneous recording of the IVP, UP and volume in awake rat revealed the urinary flow starting point in the intravesical pressure curve. What is conventionally recorded as micturition pressure, located in the middle of 4th phase, may not correspond to the true pressure during micturition.

1. *BJU Int* (2004) 94; 138-142.



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Is this a clinical trial?

No

What were the subjects in the study?

ANIMAL

Were guidelines for care and use of laboratory animals followed or ethical committee approval obtained?

Yes

Name of ethics committee

Inha University Animal Ethic Committee