

INFLUENCE OF TEMPERATURE ON URETHRA TO BLADDER MICTURITION REFLEX

Hypothesis / aims of study

The flowing of fluid along the urethra can facilitate the bladder micturition contraction, a reflex appropriate to achieve complete bladder emptying (1). This reflex can be studied in awake ewes (2): stimulation of urethral mechanoreceptors by urethral flow can induce a detrusor contraction which has the characteristics of a typical micturition reflex.

In anesthetized cats, it was demonstrated that another urethra to bladder reflex can be induced by the stimulation of urethral cold receptors (3).

The aim of this study was to research if such a reflex can be induced in awake ewes.

Study design, materials and methods

The experiments were performed on 10 adult healthy ewes¹, according to both French and European legislations on the use of live vertebrate animals for scientific research.

The animals laid on their right side, the shoulders and legs gently restrained with slings attached to the recording table. No sedative drug was used. The ewes, fully awake, remained quiet for about one hour in this position, showing no sign of discomfort. The bladder was catheterized per urethram with a 8F four-lumen balloon catheter. One channel was used for bladder filling and emptying, another for independent bladder pressure recording. The third channel opening 55 mm from the tip was used for running fluid along the urethra. The balloon (10 ml) was gently snugged at the internal urethral meatus, and secured in this position by the pull of a weight.

To study the effects of urethral flow, the bladder was filled to approximately 50% of the micturition threshold volume (MTV). MTV was defined as the minimal bladder volume inducing a large detrusor contraction.

Urethral flows were performed by injecting at the level of the proximal urethra 10 ml saline at a rate of approximately 3 ml/s. The time between two consecutive urethral flows was at least 2 minutes.

A first urethral flow was performed with saline at a temperature of 38°C and the detrusor contraction was recorded.

If necessary the bladder volume was increased until a reproducible bladder contraction induced by urethral flow was obtained.

Subsequently, the effects of urethral flows with different temperatures of the saline pushed through the urethra were tested. Temperatures tested ranged from 23 to 43 °C.

For each trial, bladder response was measured as the amplitude of the change of detrusor pressure.

ANOVAs for repeated measures were used for data analysis. Significance level was set at $p < 0.05$

Results

Urethral flows with saline at 38°C consistently trigger a detrusor contraction at subliminal bladder volumes regarding the bladder-to-bladder micturition reflex.

When the temperature of saline ranges between 17 to 37°C the detrusor contractions elicited by urethral flows are absent or significantly weaker than those triggered by body warm saline. When the temperature of saline is higher than 38°C, up to 43°C, urethral flows induce detrusor contractions similar to those induced by body warm saline.

A typical example is illustrated in Fig 1. MTV in this ewe was 100 ml. The bladder filling was 40 ml :

- 38°C saline : urethral flow elicited a strong bladder contraction (maximal amplitude : 42 cm H₂O),

- 27°C saline : urethral flow a smaller bladder contraction (maximal amplitude : 24 cm H₂O),
- 23°C saline : urethral flow fail to induce any bladder contraction

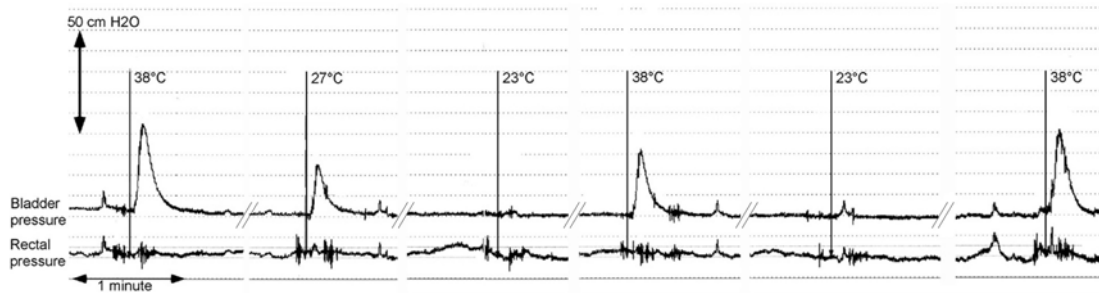


Figure n°1 : Urethral flows in a ewe. MTV was 100 ml. Temperature of saline used was 38°C, 27°C or 23°C

Interpretation of results

In all animals, the urethra-to-bladder reflex is reproducible and consistent when the saline used to perfuse the urethra is warm, at least 38°C. By contrast, it is difficult, even impossible, to induce such a reflex when the saline is at a temperature lower than the body temperature ("cold").

In anesthetized cats, either urethra-to-bladder and bladder-to-bladder reflexes are efficient with both cold and warm saline infusion showing that stimulation of mechanoreceptors or cold receptors can induce bladder contraction. In awake cats, the bladder-to-bladder cooling reflex cannot be evoked.

Concluding message

The urethra-to-bladder reflex can be observed in awake animals. However experimental procedures are to be very specific. In the ewe, when the fluid temperature is lower than the body temperature, the reflex cannot be elicited. In the same way, in an awake cat, cooling reflex cannot be evoked.

In humans, usually, saline used in urodynamic procedures is at the room temperature. With saline at such a temperature, an urethral-to-bladder reflex cannot be induced in awake ewes.

- 1) The component reflexes of micturition in the cat. Parts I and II. Brain 1931. 54:177-188.
- 2) Bladder response to urethral flow in the awake ewe. Neurourol Urodyn. 2001;20 : 641-649
- 3) Cold- and menthol-sensitive C afferents of cat urinary bladder. J Physiol. 2002 Aug 15;543 (Pt 1):211-20.