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SUPPRESSION OF THE BLADDER COOLING REFLEX IN THE AWAKE CAT: A BEHAVIOURAL STATE DEPENDANT CONTROL

Aims of Study

The bladder cooling reflex of Bors and Blinn (1) has recently been described in much detail and its value extended for revealing disturbed descending control in micturition disorders of suspected neurogenic origin (2, 3). Studies in the cat have contributed to this development, as many characteristics of the reflex are similar in cat and man (2, 4). In this context it has been puzzling that the bladder cooling reflex, absent in normal adult humans, is so easily elicited in the anesthetised cat. Is this discrepancy due to a species difference or to a state dependant (sleep/wakefulness) control of this reflex? To address this question we have now studied the bladder cooling reflex in awake cats and compared the response to that under anaesthesia.

Methods

Five adult female cats were used for the experiments. Under anaesthesia by ketamine-xylazine (15+1 mg/kg i.m.), a F6 double-lumen catheter was inserted into the bladder via a slit in the proximal urethra and secured in place. The catheter was taped to the shaved tail to have its outlets accessible. It was opened at least 3 times daily. Postoperative analgesia and antibiotics were given for the first 2 days of the survival period (3-5 days). Animals showed no clinical signs of urinary tract infections and their bladders were normal on post-mortem macroscopic inspection. Experiments were terminated by a session under similar surgical anaesthesia. When anaesthetised, normal body temperature was maintained by a feedback controlled heating device. Experimental procedures were approved by the Animal Research Ethical Committee of Linköping.

Bladder cooling reflexes were assessed when animals were fully awake and in narcotic sleep. For awake trials, the cats lay or stood on a recording table while loosely enclosed in a surgical cloth, leaving head, tail and catheter connections outside. Animals showed no discomfort and remained calm for 30-60 min. Testing was ended as soon as they became restless. One catheter channel was connected to a pressure transducer, the other was used for fluid injections into the bladder. Small volumes (5 ml) of body-warm or cold (4-8^{o} C) saline were manually injected at about 0.25 ml/s and left for 60 s before being withdrawn. These volumes were subthreshold for an ordinary A? micturition reflex, while the thermal cold stimulus lowered bladder wall temperature to about 30-32^{o} C (4). Cold and warm infusions were repeated at about 4 min intervals. A total of 160 trial infusions were performed, 71 with warm and 89 with cold fluid, of which 30 in the awake state (5-8 per animal). Bladder peak pressure in an 80 s period from start of the infusion was taken as response parameter. Control recordings showed that the bladder pressure did not differ significantly from the detrusor pressure in our experi-mental situation (difference <0.5 kPa). Data are expressed as means ± 95 % confidence interval.

Results

Typical bladder cooling reflexes were obtained in all cats when under anaesthesia. In contrast, no such reflexes were elicited when the animals were awake and alert. The difference was significant in each individual animal ($p<0.05$). Average bladder peak pressure (pooled for all animals) in response to cold infusions was 7.4±3.1 kPa during narcotic sleep compared to 2.0±1.0 kPa during wakefulness. These values are well above and below the established cut-off level for a positive bladder cooling test in humans (2). Warm control infusions induced no active bladder contractions in any state (1.2±0.5 kPa).

Conclusions

The results show that the bladder cooling reflex is suppressed in awake adult cats, just like in humans. Elucidating the origin, pathway and mechanisms of this state dependant descending control remain for future experimental studies. For these, the cat appears as a valid model to

further our understanding of micturition and continence control in humans. Our finding also adds a trait to the resemblance of the bladder cooling reflex to the Babinski´s sign: both are present in infants, suppressed with maturation of the motor control and released during narcotic sleep and after supra-sacral lesions.

References

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