

Tactile stimulation of the perigenital region during manual bladder expression improved the urine stream in cats affected by upper motor neuron injury

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OBJECTIVE

The aim of the study was to evaluate whether the tactile stimulation of the perigenital region together with manual bladder expression (MBE) facilitated the urine stream in cats with acute or chronic upper motor neuron injury (UMNI).

ANIMALS

34 cats with UMNI having urinary retention.

METHODS

All the cats had a complete neurologic examination, which determined the localization of the UMNI between T3 and L3. They were classified as chronic UMNI if the injury had occurred more than 3 days previously. The cats were divided equally into 2 groups: the M group (n = 17) managed with only MBE, and the MT group (17) managed with MBE and tactile stimulation.

RESULTS

In both groups, all the cats affected by chronic UMNI resumed urination. The time required to obtain a urine stream in the chronic UMNI was 9.3 seconds in the M group and 3.1 seconds in the MT group ($P < .05$). In the cats affected by acute UMNI, a urine stream was achieved in 54% of the M group and 100% of the MT group ($P < .05$). The time to obtain a urine stream in the acute UMNI cats was 7.8 seconds in the M group and 3.75 seconds in the MT group ($P < .05$).

CLINICAL RELEVANCE

Adding tactile stimulation of the perigenital region to the MBE improved the urine stream in cats affected by UMNI.

Keywords: cats, urination, upper motor neuron injury, manual bladder expression, tactile stimulation

In cats, upper motor neuron injury (UMNI) between the pons and L3 induces a deficit of the voluntary contraction of the detrusor muscle of the bladder due to the interruption of the propagation of the afferent signals from the bladder to the brainstem, causing a lack of elaboration of the initiation phase of the voiding process. At the same time, there is a persistent contraction of the urethral sphincters due to a lack of inhibition of the hypogastric (smooth sphincter) and pudendal (striated sphincter) nerves.^{1,2}

Initially, there is an areflexic bladder with complete urinary retention. The acute phase is followed by a recovery phase, during which significant reorganization

occurs in the spinal cord, confirming the neuroplasticity of the nervous system.

The literature reports that, within 2 to 12 weeks following spinal cord injury, a bladder-to-bladder spinal excitatory reflex emerges.³⁻⁵ This reflex can initiate automatic micturition in chronic paraplegic patients by afferent unmyelinated C-fibers, which replace the A δ fibers.

However, the bladder is usually only partially emptied because when the bladder contracts, the sphincters do not relax and do not allow efficient bladder emptying, creating chronic bladder overdistension and high postvoid residual urine over time.⁴

In these patients, on physical examination, the bladder is distended and tonic but difficult to empty manually because the tone of the urethral sphincters is normally increased due to lack of inhibition.⁶

The aim of this study was to evaluate whether adding tactile stimulation of the perigenital region to manual bladder expression (MBE) could facilitate the urine stream in cats with acute and chronic UMNI.

Methods

Animals

Thirty-four domestic cats presented to the Castellarano Veterinary Clinic, Castellarano, Italy, were selected for the study. All the selected cats had urinary retention secondary to UMNI. The study was carried out between February 2019 and January 2021. Some patients were habitual clients and were seen immediately after the trauma (acute cases); others were referred due to inability to urinate after the trauma (chronic cases). When the spinal cord injury was present for < 3 days, the cat was affected by acute UMNI; otherwise, it was classified as chronic.^{7,8} A complete neurologic examination determined the localization of the UMNI between T3 and L3 by evaluating mental state, posture, spinal reflexes, muscle tone, conscious proprioception, and motor deficits. In all the cats, the forelimbs were neurologically normal. The history reported included trauma from falling from high-rise syndrome or car crash accidents. The study considered UMNI chronic when it was more than 3 days old. The latter is the time required to start reorganising the reflex pathway activated by the C-fibers.⁷ In the referred cats affected by chronic UMNI, the urinary retention was managed by MBE before admission to the clinic. A mechanical urethral obstruction was excluded by bladder catheterization. The cats were randomly divided into 2 groups: the M group underwent only MBE, and the MT group underwent both MBE and tactile stimulation of the perigenital region. During the MBE, the cat was standing up and facing the doctor, who compressed the bladder with his right hand, applying continuous and constant external pressure over the bladder. When urine flow began, the manual pressure was maintained as the bladder decreased in size and was discontinued when the bladder could no longer be emptied. In the MT group, the doctor massaged the perigenital area with his left hand while performing MBE with his right hand. The tactile stimulation consisted of a rapid repeated manual massaging (1 to 2 times/s for 30 seconds) of the perigenital region from the prepuce to the scrotum in the males and the vulva to the anus in the females (**Supplementary Video S1**). All the procedures were performed by the same operator (FG). The time (measured in seconds) required to obtain a urine stream was recorded using a timer. The flow was considered adequate if it was continuous (not droplets) and lasted at least 2.0 seconds. When it was impossible to produce a

urine stream within 30.0 seconds, the procedure was suspended, and the subject was considered nonresponsive to the treatment. This study was a randomized, controlled field trial carried out following “Good Clinical Practice” principles and in compliance with the applicable regulatory guidelines,⁹ which were current at the time the study was performed. The Yamane formula was used to calculate the sample size. The *P* value was set at .5 with a 95% confidence level. It was performed in compliance with institutional guidelines for research on animals and approved by the ethical committee of Parma University (Prot. 10/CESA/2023). Informed consent was obtained from owners before enrolling their cats in the study.

Statistical analysis

The M group and the MT group were assayed with backward stepwise multivariable logistic regression analysis to test their interaction with the following variables: sex, sexual status, age, and body weight to verify the interaction. The differences in the results of a urine stream (namely, presence or absence) after bladder expression (ie, induction or absence of micturition) were tested via the χ^2 test. The interval between bladder expression and the beginning of the urine stream was evaluated via the Wilcoxon-Mann-Whitney test for unpaired data.

Results

There was no correlation between sex, sexual status, age, body weight, and response to MBE. The 17 cats that were in the M group (*n* = 17; 9 males [3 neutered] and 8 females [3 spayed]; age [mean \pm SD], 22.73 \pm 37.05 months) underwent only MBE. In this group, 11 out of 17 cats were affected by acute UMNI, and 6 out of 17 were affected by chronic UMNI (the chronic patients had a spinal injury present from 8 days to 5 months). The MT group underwent both MBE and tactile stimulation of the perigenital region (*n* = 17; 10 males [4 neutered] and 7 females [1 spayed]; age [mean \pm SD], 25.88 \pm 33.72 months). In this group, 12 out of 17 cats were affected by acute UMNI, and 5 out of 17 were affected by chronic UMNI (in this group, the spinal trauma was reported from 1.5 months to 4 months).

In the cats affected by acute UMNI, urine stream response was observed in 6 out of the 11 cats in the M group and 12 out of 12 cats in the MT group (*P* > .05). In the cats affected by chronic UMNI, urine stream response was observed in all 6 cats in the M group and all 5 cats in the MT group (**Figure 1**).

The time (in seconds) between the MBE and the beginning of the urine stream was reduced by tactile stimulation in acute UMNI (3.7 \pm 2.0 seconds vs 7.8 \pm 3.5 seconds) and the chronic UMNI (3.1 \pm 2.7 seconds in the MT group vs 9.3 \pm 5.5 seconds in the M group, respectively; *P* < .05); statistical differences were found between the MT group and the M group (*P* < .05; **Figure 2**).

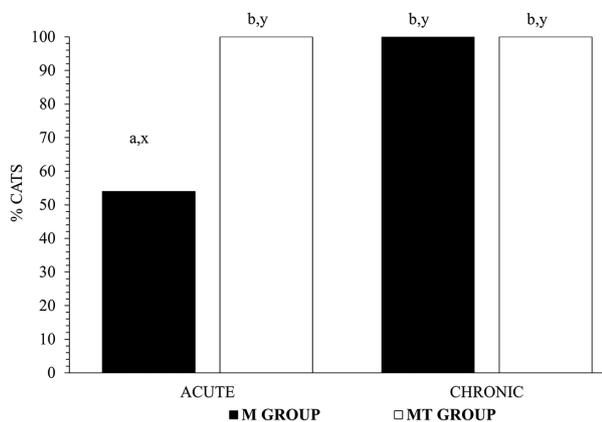


Figure 1—Percentage of cats affected by acute or chronic upper motor neuron injury that presented a urine stream after manual bladder expression (MBE; M group; n = 17) and MBE and tactile stimulation of the perigenital region (MT group; 17). a, b = Significant differences ($P < .05$) within a group. x, y = Significant differences ($P < .05$) between groups.

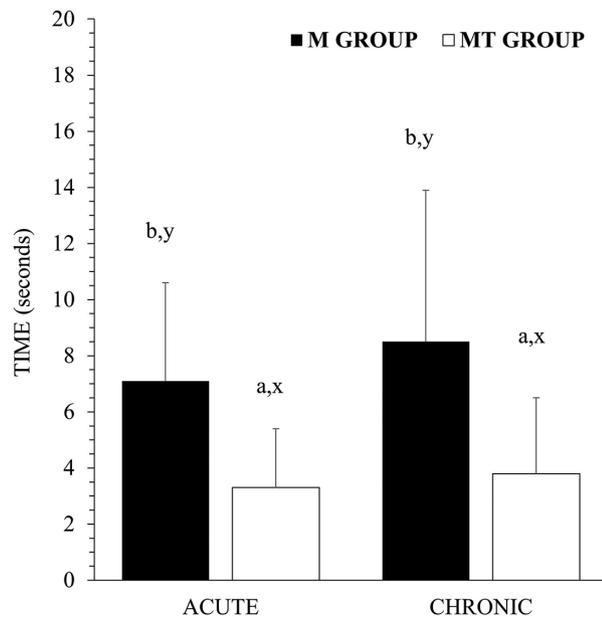


Figure 2—Time (seconds) between the beginning of the urinary stream in the cats undergoing MBE (M group) and in the cats undergoing MBE and tactile stimulation of the perigenital region (MT group). **See** Figure 1 for key.

Discussion

The perigenital-to-bladder spinal reflex is physiological in newborn cats and is activated by the mother licking the perigenital area of the kitten.¹⁰⁻¹² The licking of this region activates the somatic afferent fibers contained in the pudendal nerve. These pudendal afferent fibers, in turn, via a reflex arc which is localized in the sacral spinal cord, activate vesical parasympathetic efferent pathways that travel along the pelvic nerve to innervate the bladder and induce bladder contractions (activating the M3 muscarinic

receptors); they coordinate urethral sphincter activity, resulting in complete bladder emptying.¹³ In a previous study,¹¹ 3-week-old kittens experienced complete urinary retention after being isolated from their mothers. This study demonstrated the need for tactile stimulation to promote urination. Another study¹⁴ has shown that perineal stimulation induced voiding and coordinated bladder/sphincter activity in nonspinalized and spinalized neonatal rats. In contrast, the uncoordinated bladder/sphincter activity was observed during voiding induced by bladder distension in spinalized pups. This may explain why micturition in the bladder-to-bladder spinal reflex is ineffective. When the bladder contracts, the sphincters do not relax, while the perigenital-to-bladder spinal reflex induces efficient voiding and coordinated bladder and sphincter activity.

Our hypothesis was that, because bladder/sphincter dyssynergia is elicited during distension-induced bladder contractions but not during perineally induced bladder contractions in neonates, perineal afferent activity suppresses the guarding reflex (ie, that reflex which contracts the sphincters to maintain continence during bladder filling). Similar conclusions have also been noted in cats by Tai et al.¹⁵ These data indicated that only specific afferent pathways could efficiently activate the spinal pathways responsible for generating bladder-sphincter coordination.

MBE induces voiding when the bladder pressure induced by mechanical compression overcomes the pressure of the urethral sphincters. It can be deduced that MBE associated with tactile stimulation of the perigenital area can improve voiding owing to the reduction of the tone of the urethral sphincters.

De Groat et al^{7,8} demonstrated the reemergence of the perigenital-to-bladder spinal reflex by tactile stimulation at least 1 to 2 weeks after spinal transection. This reflex increases in intensity in the 2-week period that follows. In the present study, it was hypothesized that, after UMNI, the perigenital-to-bladder spinal reflex reemerged initially only on a subliminal level by tactile stimulation, most likely in the early phase. The reflex is not optimized in urinary bladder contraction; however, in the first hours, it can facilitate urination, thanks to the relaxation of the urethral sphincters. This hypothesis could explain why within a few hours of the trauma, all the acute patients receiving tactile stimulation of the perigenital-to-bladder spinal reflex were able to induce urinary voiding immediately after the combined MBE and tactile stimulation.

As shown in the results, the current study revealed no significant differences in flow onset urinary tract times in chronic and acute spinal cord injury cats when a protocol of MBE and tactile stimulation was used.

This study also showed that the interval between MBE and the time of initiating a urine stream was significantly reduced by tactile stimulation of the perigenital region in cats with an acute or chronic UMNI, thanks to the activation of the perigenital-to-bladder spinal reflex.

The practical implications of the results of this study are that tactile stimulation of the perigenital region during MBE can reduce the patient's discomfort and the time of hospitalization and facilitate cat

management at home. Furthermore, a shorter time of bladder compression reduces the risk of vesicorenal reflux and the transient dilation of the renal pelvis with deterioration of the renal function.

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Disclosures

The authors have nothing to disclose. No AI-assisted technologies were used in the generation of this manuscript.

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Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org