Ejaculation elicited by microstimulation of lumbar spinothalamic neurons

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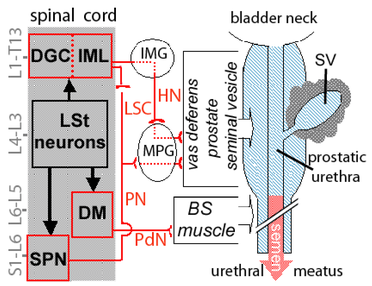
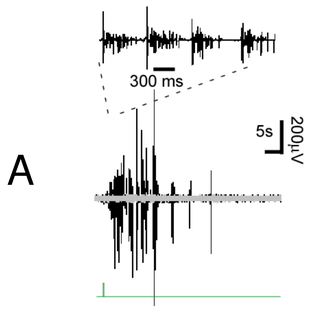
LSt neurons connect to anatomical structures involved in ejaculation



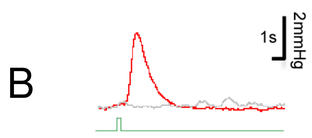
Schematic representation of known connections of lumbar spinothalamic (LSt) neurons with pelvi-perineal structures involved in ejaculation in rat**. DM = dorsal medial part of Onufs' nucleus; SPN = sacral parasympathetic nucleus; SGC = dorsal gray commisure; IML = intermediolateral nucleus; PdN = pudendal nerve; PN = pelvic nerve; LSC = lumbosacral paravertrebral sympathetic chain; HN = hypogastric nerve; IMG = intermesenteric ganglion MPG = major pelvic ganglion; BS = bulbospongious; SV = seminal vesicle

**Adapted from: C. Xu *et al.* Neuroscience no.134, pp1325-41, 2005 and no.138, pp561-73, 2006

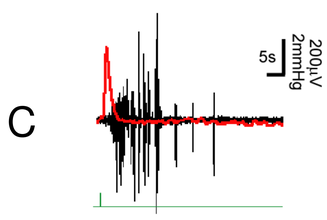
Electrical stimulation of LSt neurons elicits ejaculation-related events



Brief electrical microstimulation in the LST neuron area (green line) evokes rhythmic bursting in the BS muscle EMG that lasted for about 25 s (**A**; background activity in gray). BS muscle activity represents the expulsion phase of ejaculation.

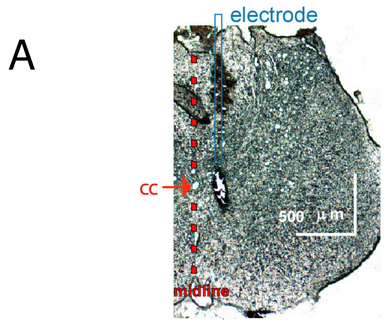


Brief electrical microstimulation in the LST neuron area (green line) evokes a change in SV pressure that lasted for about 3 s (**B**; background activity in gray). SV pressure change represents the emission phase of ejaculation.

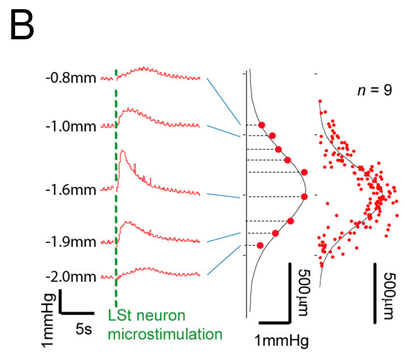


BS muscle EMG and SV pressure change evoked by electrical stimulation in the LST neuron area (green line) recorded from the same animal (**C**; same data as in **A**, **B**). The overlay highlights the sequential activation of SV and BS muscle. In 10/17 experiments this was followed by the expulsion of living spermatozoa from the urethral meatus.

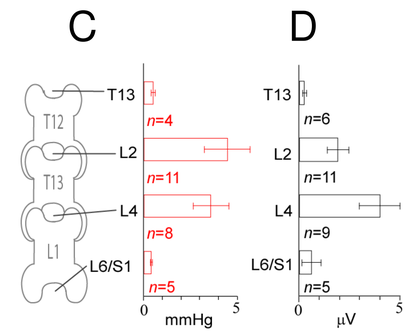
The spinal area from which ejaculation-related events are evoked matches the LSt neuron area



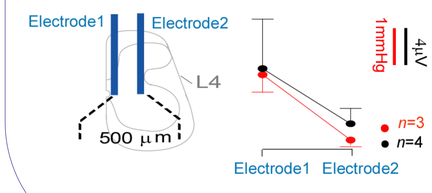
Strong current injection after microstimulation marks the spinal location of the microstimulation electrode. (**A**; spinal cord section at segment L4). Ejaculation and ejaculation-related events were successfully triggered 210 ± 30 µm (*n* = 12) lateral from the central canal (cc) at L4 level.



Sampling different electrode depths along the dorso-ventral axis shows systematical variation of the SV pressure peak response (red dots) (**B**). The maximum peak response was found -1620 ± 35 µm (*n* = 9) below the spinal surface. This corresponds with lamina VII/X.



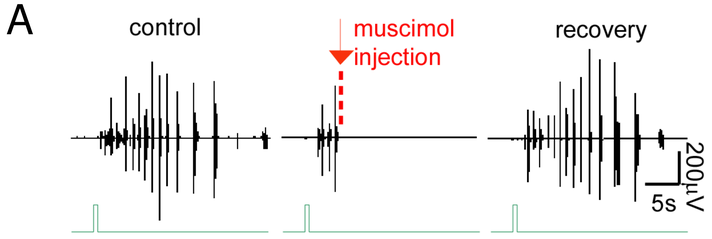
For the rostro-caudal axis, equally sized responses for SV peak pressure (**C**) and BS muscle activity (**D**)are found in spinal segment L2 and L4. Almost negligible responses are found at T13 and the L6/S1 border.

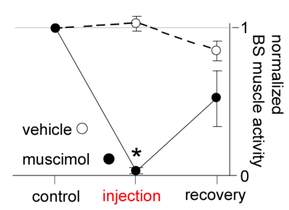


For the medio-lateral axis, two electrodes were placed in L4, spaced 500 µm apart. The medially placed electrode gave larger responses for both SV (red) and BS muscle (black) (**E**).

Panels **A-E** demonstrate the good match between stimulation area and LSt neurons, which locate around de central canal of spinal segments L1-L5.

LSt neuron activity not only triggers ejaculation, but is also required to maintain it





Local muscimol injection in the LSt neuron area shortly after LSt neuron microstimulation (green line) blocks the evoked BS muscle activity in midstream. The response recovers after about 20 minutes (**A**). The average BS muscle response is shown for muscimol (50 µM, *n* = 5) and vehicle (*n* = 4) injection (**B**).

Conclusions

- Electrical microstimulation in the LSt neuron area activates the entire sequence of ejaculation in rats in a coordinated fashion, i.e. the emission (SV pressure change) followed by the expulsion (rhythmic BS muscle activity) of living spermatozoa
- Midcourse interruption of ejaculation following intraspinal muscimol injection demonstrates that LSt neurons not only trigger but also maintain ejaculation, establishing LSt neurons as a crucial component of the spinal generator for ejaculation
- Given the comparable organization of ejaculation in rats and humans, these results could help to identify spinal pharmacological target for the treatment of ejaculatory disorders

Methods

Adult male rats were kept under urethane anesthesia and maintained at 37 °C. Electrodes were implanted in the BS muscle and the SV was catheterized. After expose of spinal segment L4, the stimulation electrode was lowered into the LSt neuron area. Electrical stimulation of the LSt neurons consisted of a 0.3-0.5 duration train of 0.5 ms pulses (200 Hz, 15-100 µA), while recoding BS muscle EMG and SV pressure change. For intraspinal drug delivery, a glass micropipette was glued to the electrode, connected to a "Picospritzer". Pressure injection duration was 400 ms, with 200-500 nl injected volume. For BS muscle activity quantification, the EMG signal was rectified, 200 Hz low-pass filtered and the mean value calculated between 1 and 25 s after stimulation.
Full experimental details will be published in: A.J. Borgdorff *et al. 2008. European Urology, in press.*

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