ABSTRACT # 1626

ELECTRICAL STIMULATION OF INTERMESENTERIC NERVES ELICITS PELVIC ORGASM-LIKE RESPONSE IN ANESTHETIZED FEMALE RATS

F Giuliano[1,2*], J Bernabé[1], S. Droupy [2], G. Benoit [2], L Alexandre[1], J Allard[1]

* giuliano@cyber-sante.org

[1] PELVIPHARM Laboratories, Gif-sur-Yvette, France [2] Research Group in Urology, Medical University of Paris South, Le Kremlin-Bicêtre, France

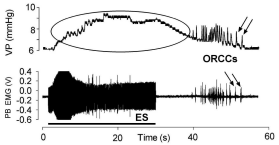
ABSTRACT

Introduction and Objective: Orgasm in women is associated with rhythmic muscular pelvic floor contractions and associated increases in vaginal pressure (VP). The neurophysiological support of the orgasm-related rhythmic pelvic contractions (ORRCs) is yet unexplored. Because electrical stimulation (ES) of the intermesenteric nerve (IMN) could induce ejaculation under isoflurane-anesthesia in male rats, we assessed whether ES of the IMN, and additionally ES of the dorsal nerve of the clitoris (DNC), could reproduce the ORRCs in female rats.

Methods: VP and pubococcygeus muscle electromyogram (PB EMG) were continuously recorded in isoflurane-anesthetized Wistar rats. Groups of 4-5 rats were submitted to ES of the intact IMN, of the proximal or distal stump of the cut IMN, or of the intact IMN after T8 spinalization (1 ms, 6 V, 80 Hz for 30 s). ES of the DNC was performed in control and T8 spinalized rats (0.1 ms, 5 V, 5 Hz for 30 s).

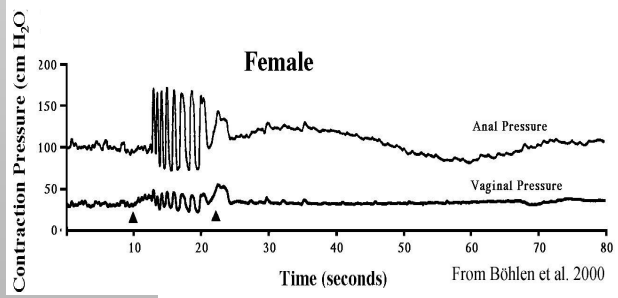
Results: An example of response is given on the recording. More than 80% of ES of the IMN induced a transient rise of VP (loop) and ORRCs, accompanied by corresponding rises in VP (arrows). There was no effect of spinalization on the incidence of ORRCs and transient rise in VP upon ES of the IMN. ES of the distal stump of the cut IMN could not elicit any ORRCs, but induced a transient rise in VP. ES of the proximal stump systematically induced ORRCs and a transient rise in VP. ES of the DNC did not induce any ORRCs or rise of VP in either intact or T8 spinalized rats.

Conclusions: ES of afferences in the IMN can elicit ORRCs similar to the ones observed in women during orgasm (Bohlen et al., Arch Sex Behav, 1982, 11:367), through aspinal reflex. We hypothesize that the presently observed ORCCs are a vestige of the rhythmic contractions of the bulbospongiosus and perineal muscles (expulsion reflex) observed during ejaculation in males. ORRCs could not be obtained by stimulating somatic sensory fibers from the genitals (DNC) and were not abolished by T8 spinalization when elicited by ES of the IMN. Therefore, the neural control of ORRCs in male (i.e. expulsion reflex) and female rats remarkably differs, raising the possibility of fundamental differences in the neurophysiological control of peripheral orgasm-related responses in men and women.



BACKGROUND

- Female orgasm is a spinal reflex
- Evidence indicates that sexual climax (orgasm) is a reflex mediated by the spinal cord, which may involve a spinal pattern generator
- Women with injury of the lower motor neurons and S2-S5 dermatomes are less likely to reach orgasm through direct genital stimulation compared to women with injury at or above T11.
- Data suggest that orgasmic responses require intact reflexes that relay in the sacral spinal cord.
- Few animal models have attempted to mimic the physiological changes during orgasm.



From Böhlen et al. 2000

Urethrogenital reflex – a model of 'climax' :

In acutely spinalized female rat, genital stimulation evoking i.e. results in rhythmic contractions of the striated perineal muscles, vaginal, anal and uterine contraction. Uthis response is called the urethrogenital reflex.

The urethrogenital (UG) reflex is a sexual response that is generated by a multi-segmental spinal pattern generator, which involves the coordination of sympathetic, parasympathetic and somatic efferents innervating the genital organs.

The neural responses are similar in males and females.

The reflex is a spinal reflex, similar to the orgasmic reflex described in spinal cord injured patients.

Recordings in women during orgasm have shown coordinated rhythmic contractions of the vagina and anal sphincter that are virtually identical to recordings obtained during the UG reflex in the female rat.

The UG reflex model has been used to examine the CNS control of genital reflexes.

Marson L, McKenna KE. Exp Brain Res. 1992;88(2):313-20.

Committee 7: Physiology of Female Sexual Function

Goldstein I. Marson L. International Consultation on Sexual Dysfunction, Paris 2003

Peripheral regulation of orgasmic reflexes

Orgasmic reflexes regulated by somatic and autonomic nerves

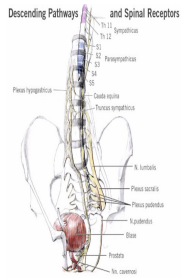
Pudendal (somatic) nerve relays sensory stimuli from external genitals, perineum, clitoris, urethra and pelvic floor musculature - sensory signals are essential for urethrogenital (UG) reflex

Pelvic (light touch, noxious or chemical stimuli of the vagina, cervix, and uterus) and hypogastric nerves (transmission of noxious stimuli from the uterus and genital vasocongestion) mediate sensory information from internal pelvic organs

Role of pelvic and hypogastric afferents in mediation of other sensory inputs during orgasm not known

Neural activity in pelvic, pudendal and hypogastric nerve afferents sensitive to level of gonadal steroid hormones

Pelvic, pudendal and hypogastric nerves may be important in hormone sensitive reflexes



OBJECTIVES

• To develop in female rat an experimental model to investigate the physiology of orgasm which is, in women, associated with rhythmic muscular pelvic floor contractions and increases in vaginal pressure (VP).

METHODS

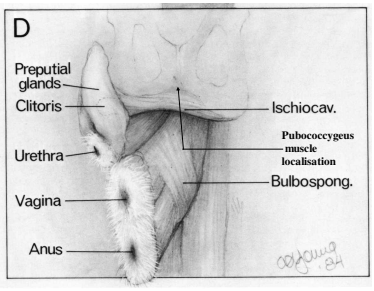
• Adult female Wistar rats were used for the experiments.

• After standard surgical preparation under isoflurane-anesthetisia, the intermesenteric nerves (IMN) were exposed with the aid of a dissecting microscope and mounted on bipolar platinum electrodes connected to an electrical stimulator (AMS 2100, Phymep, France).

• Vaginal pressure (VP) was recorded with an intravaginal balloon (Harvard Apparatus 73.003).

• Pubococcygeus muscle electromyogram (PB EMG) was continuously recorded in by placing two thin bared silver electrodes 1-2 mm apart into the muscle. Recorded signal was amplified (DP-301, Warner Instrument Corp., Phymep; gain, 10000; Low pass, 10 KHz; High pass, 10 Hz) before being digitized.

• Groups of 4-5 rats were submitted to electrostimulation (ES) of the intact IMN, of the proximal or distal stump of the cut IMN, or of the intact IMN after T8 spinalization (1 ms, 6 V, 80 Hz for 30 s). ES of the dorsal nerve of clitoris (DNC) was performed in control and T8 spinalized rats (0.1 ms, 5 V, 5 Hz for 30 s).



Perineal muscles of Female rat (D)

Dissection showing the location and appearance of the ischiocavernosus and bulbosponigosus muscles. The location and appearance of the anal and urethral sphincters in the female are the same as in the male. Ventrolateral view.

McKenna KE, Nadelhaft I. The organization of the pudendal nerve in the male and female rat. J Comp Neurol. 1986 Jun 22;248(4):532-49.

RESULTS

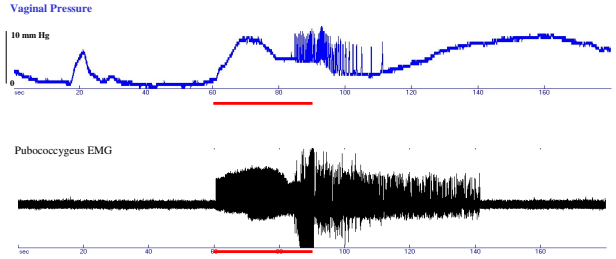
More than 80% of electrical stimulation (ES) of the IMN induced a transient rise of VP and post-stimulation pubococcygeus muscle rythmic contractions accompanied by increases in VP .

There was no effect of spinalization on the incidence of post-stimulation pubococcygeus muscle rythmic contractions and transient rise in VP upon ES of the IMN.

ES of the distal stump of the cut IMN could not elicit any post-stimulation pubococcygeus muscle rythmic contractions, but induced a transient rise in VP.

ES of the proximal stump of the cut IMN systematically induced post-stimulation pubococcygeus muscle rythmic contractions and a transient rise in VP.

ES of the dorsal nerve of the clitoris (DNC) did not induce any post-stimulation pubococcygeus muscle rythmic contractions or rise of VP in either intact or T8 spinalized rats.



1 ms, 6 V, 80 Hz for 30 s

Increase in vaginal pressure and reflex rhythmic contractions of the pubococcygeus muscle after the end of the electrostimulation of the IMN.

Electrical signals recorded within the pubococcygeus muscle during electrostimulation of the IMN are artefactual. They were not abolished after curarisation (n=4) of the animal while rise in vaginal pressure remained and post stimulation contractions within the pubococcygeus muscle were abolished.

CONCLUSION

➢ ES of afferences in the IMN can elicit pubococcygeus muscle rythmic contractions and transient rise in intravaginal pressure similar to the ones observed in women during orgasm.

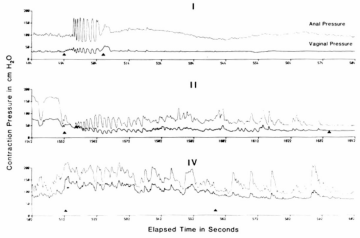


Fig. 3. Orgasmic contractions of subjects representing three pattern types (I, II, and IV).

(Bohlen et al., Arch Sex Behav, 1982, 11:367).

➢ We hypothesize that the presently observed pubococcygeus muscle rythmic contractions are the counterpart of the rhythmic contractions of the bulbospongiosus observed during the expulsion phase of ejaculation in males (see # 1632).

➢ Surprisingly the pubococcygeus muscle rythmic contractions could not be elicited by stimulating sensory fibers from the dorsal nerve of the clitoris in our experimental conditions. These striated muscle contractions were not abolished by T8 spinalization when elicited by ES of the IMN.

➢ Therefore, the neural control of orgasm-like response in males and female rats remarkably differs (#1632), raising the possibility of fundamental differences in the neurophysiological control of peripheral orgasm-related responses inboth sexes.