ORIGINAL RESEARCH—ANATOMY/PHYSIOLOGY

The Quality of Sexual Experience in Women Correlates with Post-Orgasmic Prolactin Surges: Results from an Experimental Prototype Study

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ABSTRACT

Introduction. Sexual intercourse, orgasm, and sexual satisfaction are associated with well-being and improved quality of life. The pituitary hormone prolactin (PRL) may have an important role in regulating (and thus indexing) sexual satiety and satisfaction.

Aim. Physiological indices to quantify the quality and resulting satisfaction from female orgasm would be valuable. Therefore we aim to validate associations of orgasm-induced PRL surges with women's orgasm quality and subsequent sexual satisfaction.

Methods. In a prospective study, with a pre-post, single-blinded, cross-over design in a naturalistic field setting, we analyzed the correlation of women's post-orgasmic serum PRL surges following sexual intercourse with women's perceived quality of orgasm and resulting sexual satisfaction, as measured by a questionnaire.

Main Outcome Measures. PRL levels prior to and following penile-vaginal intercourse with and without orgasm, and scores from the Acute Sexual Experience Scale (ASES) on quality of orgasm and sexual satisfaction.

Results. An analysis of variance of the blood samples in nine women indicated large magnitude, significant effects of intercourse orgasm on PRL levels ($P = 0.004$, eta squared = 0.78), as well as an interaction with the effect of multiple orgasms ($P = 0.008$, eta squared = 0.80). PRL post/pre ratios and arithmetic difference correlated strongly with orgasm quality ($r = 0.85$, $P = 0.016$, and $r = 0.69$, $P = 0.08$) and sexual satisfaction ($r = 0.75$, $P = 0.05$ and $r = 0.77$, $P = 0.045$).

Conclusion. Women's intercourse orgasm induced PRL surges are strongly related to the quality of orgasm and subsequent sexual satisfaction. This implies that post-orgasmic PRL surges are an objective index of orgasm and orgasm quality. PRL might be used in future studies on basic research as well as a treatment target in sexual disorders in women. **Leeners B, Kruger THC, Brody S, Schmidlin S, Naegeli E, and Egli M. The quality of sexual experience in women correlates with post-orgasmic prolactin surges: Results from an experimental prototype study. J Sex Med 2013;10:1313–1319.**

Key Words: Prolactin; Female Orgasm; Sexual Intercourse; Human; Mid-Cycle

Introduction

Aspects of sexual activity and satisfaction are linked to improved life quality and general well-being [1–4]. Regular sexual activity, especially the presence of orgasm, may have beneficial effects for both psychological and physical well-being [4].

The first two authors have contributed equally to the manuscript.

Specifically, penile–vaginal intercourse and the orgasm it produces (in contrast to other sexual activities) is associated with greater sexual and relationship satisfaction [5,6], better emotional function [7], and greater resting heart rate variability (an index of cardiovascular autonomic function prospectively associated with longevity) [8]. Sexual satisfaction proved to be one of the strongest predictors of marital satisfaction and stability [9,10]. The strength of the relationship between sexual satisfaction and well-being seems to be particularly strong in women [11]. Although recent results have demonstrated that in women, factors such as emotional and physical closeness to the partner, self-determination realized in a partnership, satisfaction of communicational desires, and need for tenderness within the partnership correlate with sexual satisfaction, orgasm remains one of the most important aspects for a fulfilling sexual relationship [12–14].

Recent research suggests that for both sexes, the pituitary hormone prolactin (PRL) may have an important role in regulating and/or indicating sexual satiety and satisfaction [15–18].

Although previous research provided a strong argument for PRL changes being an objective measure of sexual satiety [19–21], there was a need to examine directly the association between orgasm-induced changes in women's PRL levels and women's subsequent ratings of orgasm quality and sexual satisfaction.

Aims

To elucidate the sexual satisfaction and orgasm quality indexing role of orgasm-induced PRL secretion in women, we analyzed the correlation of serum PRL changes following women's sexual intercourse orgasm with women's perceived quality of the orgasm as well as women's resulting sexual satisfaction. To augment external validity, we used a naturalistic field setting combined with assessment of PRL plasma levels.

Methods

Study Subjects

A total of 32 heterosexual couples were screened to determine their eligibility for participation in the study. Subjects were recruited via advertisements by the Swiss Federal Institute of Technology (ETH Zurich) and the University of Zurich, Switzerland. Twelve couples fulfilled inclusion criteria. The screening process included a general medical examination and a health questionnaire, incorporating gynecological history. Individuals on medication, abusing drugs/alcohol, or exhibiting endocrinological, gynecological, psychological, sexual, or any other somatic dysfunctions/disorders were excluded from the study. However, 3 of the 12 couples were excluded from the analyses due to missing data either from blood sampling or from the questionnaire. Thus, data from nine women were obtained. Characteristics of the study participants are summarized in Table 1. All women were clinically evaluated as physically and psychologically healthy non-smokers without any current medication. None of the participants had given birth. All were heterosexual, reported absence of any sexual disorder, and estimated their current relationship as very important for their well-being. All couples were sexually active and had been in a relationship for at least 12 months. Only those women who reported a regular menstrual cycle and who used non-hormonal contraception methods were included.

Table 1 Characteristics of study participants

	Mean	SE	Range
Age (years)	24.6	±3.50	21–31
BMI	20.7	±2.32	17.4–23.7
Menstrual cycle length (days)	28.4	±1.19	26–30
Duration partnership (months)	37.7	±26.11	12–84

Written informed consent was obtained from the couples after thorough explanation of the study (oral and written). Participants were made aware of their right to discontinue participation at any time, and that their data would be confidential. All experiments were conducted in accordance with the Declaration of Helsinki. The protocol for the study was approved by the Ethics Committee for investigations involving human subjects of the Canton Zurich, Switzerland.

Study Design

The investigation was performed using a prospective, pre-post, single-blinded cross-over design.

Due to the importance of the cycle phase on sexual behavior and reproductive function [22], as well as the variation of physical influences on sexual satisfaction throughout the menstrual cycle [12], all investigations were timed during the mid-cycle/pre-ovulatory period confirmed by using a Luteinizing Hormone (LH)-based ovulation test (Evial Ovulationstest Strip, Inopharm, Bern, Switzerland). The pre-ovulatory period was chosen to achieve data on the interaction between

sexual activity and endocrinological regulation patterns in the context of human reproduction. With regard to the circadian rhythm of endocrine parameters and for reasons of comparability, all investigations started at 5 PM. All women were measured in two conditions: in one condition (experimental condition) measurements were performed after engaging in sexual intercourse, and in the other condition blood samples were collected at exactly the same time intervals without any sexual activity (control condition). Whether the first measurement series was sexual intercourse or the control condition was assigned randomly. For the measurements after sexual intercourse, couples were asked to have penile-vaginal intercourse at home at 7 PM ± 0.5 hours, the total sexual contact (including foreplay) lasting approximately 0.5 hours. All participants were asked to abstain from drinking alcohol as well as from exhausting physical exercise during the 24 hours prior to the blood sampling. Furthermore, they were told not to consume more than three cups of coffee. Moreover, for both conditions, couples were asked to refrain from any kind of sexual activity for at least 96 hours prior to the study.

Blood Collection

Blood sampling was initiated by a first blood withdrawal at 5 PM. To avoid a confounding effect of the stress associated with the implementation of the venous catheter, this was 1.5–2.5 hours before sexual contact and after a resting period of at least 30 minutes. These samples served as baseline. After the sexual contact, consecutive blood samples of the female participants were taken in their regular environment (home/work place) to avoid any possible effects of being in an unusual (laboratory) environment during sexual activity, as well as to reduce confounding stress to a maximum. The post-contact sample was drawn within 30 minutes after sexual intercourse, after the experimenter was telephoned by the couple when intercourse ended or about 2.5 hours after the basic measurement in the control condition without sexual intercourse. Serial blood samples were taken as previously described [18]. In brief: i.v. cannula (Vasofix Braunüle 18G, Braun, Germany) were inserted into a forearm vein of the non-dominant arm. Stylets (Vasofix-Mandrin, Braun, Germany) were used for the closure of the indwelling cannula to inhibit blood coagulation. About 10 mL blood was collected through the inserted venous catheter in EDTA tubes (Sarstedt, Nümbrecht, Germany) at each time point. Blood samples were immediately stored on ice until the samples were centrifuged for 10 minutes at 7°C with 2,300 rpm to separate plasma from blood cells. Plasma samples were then stored at –80°C until further analysis of endocrine parameters.

PRL Assessment

All samples from a participant were assayed in duplicate within the same assay. The laboratory personnel performing assays of PRL plasma levels were blinded for the time of the blood sample and whether it was drawn after the experimental condition with intercourse or the control condition without intercourse. PRL plasma levels were detected by the Automated Chemiluminescence-Immunoassay-System 180 (ACS: Centaur; Chiron Diagnostics, Leverkusen, Germany). The intra- and interassay coefficients of variance were 2.5% and 3.6%, respectively. PRL surges (indexed as both ratio and arithmetical difference between the baseline PRL level and the post-orgasmic PRL level) were the endocrine variable examined in the correlational analyses, with the absolute pre and post values used in the repeated measures analysis of variance.

Investigation of Sexual Parameters

Based on items from the Acute Sexual Experience Scale (ASES) questionnaire [17], women provided self-report ratings of dimensions of sexual experience using visual analog rating scales (0–100 from "not at all" to "extremely"). The ASES was designed to investigate acute sexual experience in a specific situation such as masturbation or sexual intercourse [17]. The total questionnaire includes 23 items evaluating different characteristics of female sexual behaviour. To address the current research questions, we chose the subscale investigating orgasm with one question examining the quality, and another question measuring sexual satisfaction after orgasm. For both questions, higher values on the visual analog rating scale indicated higher quality/satisfaction.

Statistical Analysis

We verified the statistical significance of the post-orgasmic PRL surges and the effect of multiple orgasm with a repeated measures analysis of variance, with the within-subjects factor being PRL levels before and after intercourse, and the between-subjects factor being number of orgasms. We examined the association of post-orgasmic PRL surges with orgasm quality and sexual satisfaction with Pearson correlation coefficients. A

Table 2 PRL values in control and experimental conditions

		PRL* values in ng/mL (±SD)				
N of orgasm		0	1	2	any	total
Control conditions	Pre	—	—	—	—	8.76 (±2.43)
	Post	—	—	—	—	8.11 (±2.00)
	Delta	—	—	—	—	–0.68 (±0.43)
Experimental conditions (sexual intercourse)	Pre	9.08 (±1.27)	9.01 (±6.01)	12.64 (±0.94)	10.04 (±5.23)	9.83 (±4.57)
	Post	7.76 (±1.15)	18.99 (±8.87)	65.80 (±26.45)	32.37 (±26.28)	26.90 (±25.21)
	Delta	–1.32 (±0.12)	9.99 (±7.93)	53.16 (±25.5)	19.38 (±24.06)	17.07 (±23.54)

*PRL = prolactin; significant effects on PRL of both pre/post-penile–vaginal intercourse orgasm ($F(1,6) = 21.2$, $P = 0.004$, eta$^2 = 0.78$), as well as an interaction with the effect of multiple orgasms ($F(2,6) = 11.7$, $P = 0.008$, eta$^2 = 0.80$)

two-tailed alpha of 0.05 was considered statistically significant for all analyses. SPSS for Windows version 13.0 was used for analyses.

Main Outcome Measures

Main outcome measures were PRL surges after penile–vaginal intercourse with and without one or two orgasms (thus, zero, one, or two orgasms). In addition, we investigated the correlation between PRL surges and the quality of orgasm (for the women having one or two orgasms) as well as sexual satisfaction following intercourse.

Results

All couples had sexual intercourse within the given time frame. Of the nine investigated women, five reported having one orgasm, and two reported having two orgasms during intercourse. The length of total sexual activity was 38.2 minutes (±14.9) on average.

PRL values in the experimental and the control condition for women experiencing zero, one, two, or any orgasm are presented in Table 2 and Figure 1.

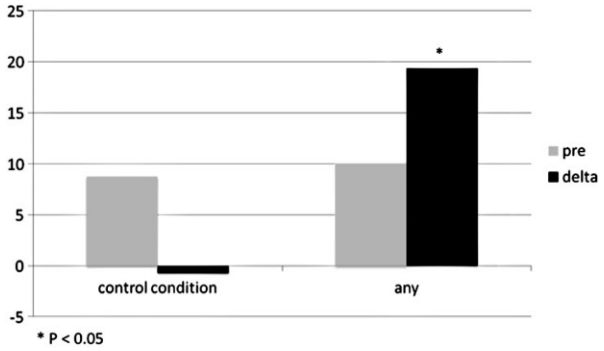

Figure 1 Prolactin values in control and experimental condition with orgasm

The analysis of variance indicated large magnitude, significant effects on PRL of both pre/post penile-vaginal intercourse orgasm ($F(1,6) = 21.2$, $P = 0.004$, eta squared = 0.78), as well as an interaction with the effect of multiple orgasms ($F(2,6) = 11.7$, $P = 0.008$, eta squared = 0.80). PRL surges were higher in women who experienced two orgasms compared to those who had one orgasm. In women who experienced no orgasm, post-orgasmic PRL levels were slightly lower than pre-orgasmic PRL values, indicating no surge, and therefore far less than for women who had an orgasm.

PRL post/pre ratios and arithmetic difference correlated with: orgasm quality ($r = 0.85$, $P = 0.016$, and $r = 0.69$, $P = 0.08$) and sexual satisfaction ($r = 0.75$, $P = 0.05$, and $r = 0.77$, $P = 0.045$), but not with duration of sexual contact.

If one were to collapse the data (eliminating details on number of orgasms among the women who had an orgasm by dichotomizing the results into any or no orgasm, and thus decreasing specificity and statistical power), statistical significance would be lost for significance of PRL changes, except for the delta scores. Thus, it is important to record information on number of orgasms, as this seems to have an important influence on PRL responses in women.

Discussion

The current data demonstrate that the magnitude of the intercourse post-orgasmic PRL surge correlates strongly with both orgasm quality and with subsequent sexual satisfaction. Women who experience an orgasm show a large increase of PRL, but women who had no orgasm present slightly reduced PRL levels. Thus, there is support for the use of PRL surges as an objective measure of orgasm and orgasm quality.

Results from Krüger et al. [15–18] demonstrated that PRL increases for at least 60 minutes following orgasm in males as well as in females [18,20]. Moreover, orgasm-induced PRL surges

even on the following day [18]. This suggests a sustained effect of orgasm on neuroendocrinological functions related to reproductive behaviors, similar to what was shown in a rat model [23].

In the present study, we show that the amplitude of women's post-orgasmic PRL surge correlates strongly with their orgasm quality and the sexual satisfaction from the sexual contact. The duration of the intercourse, however, had no influence on PRL changes. The fact that the orgasm induced by penile–vaginal intercourse creates a dramatically larger PRL surge than by masturbation [24], and that the nature of orgasm differs depending on its induction (sexual intercourse, masturbation, or partnered sexual activities other than pure penile-vaginal intercourse) [4] suggests a role of prolactin (in itself, and/or reflecting central dopaminergic as well as serotonergic activity) in the differential effects of various sexual activities and responses. In addition, clitoral and vaginal/cervical stimulation are associated with different peripheral as well as central nervous system pathways [25]. Dopaminergic pathways are likely to induce PRL surges, and differences of PRL plasma levels might be considered in the context of other neuroendocrine changes, for example those of testosterone [26]. An increase in central serotonergic activity as a result of treatment with selective serotonin reuptake inhibitors (SSRIs) is known to decrease all components of the sexual reaction including orgasm [27]. Consequently, serotonin seems to be an additional potential regulator of the probability and, eventually, quality of orgasm. However, the understanding of the healthy physiological interaction of different neurotransmitters in human female orgasm is only at its dawn.

Our results additionally show that not only the quality but also the quantity of the orgasms is related to the post-orgasmic PRL surge. PRL surges were higher in women who experienced two compared to one orgasm, and women with no orgasm showed no increase in PRL at all.

Chronic elevations of PRL (i.e., hyperprolactinemia either physiologically during lactation, induced by PRL-secreting tumors or as a side effect of typical neuroleptics) produce pronounced reductions of sexual drive in humans [28–30]. Importantly, these effects are reversed upon pharmacological or surgical restoration of normal PRL levels [31]. Acute PRL manipulation may have a significant impact on sexual drive and sexual function in men [17]. The fact that prolactin-raising antipsychotics and the resulting tonic increase of PRL are associated with decreased libido and difficulties to achieve orgasm, which is reversible after normalization of PRL values, further emphasizes a role of PRL in the regulation of sexual satiety [32–34]. The hypothesis that PRL functions as a sexual desire regulating hormone is also supported by results showing that serum PRL is only substantially increased following orgasm but not following sexual arousal without orgasm [15,16]. However, as the current stage of research does not allow the conclusion that PRL per se affects sexual desire (for example, endogenous PRL changes might be secondary to central dopaminergic processes), we can presently only state that PRL is correlated with sexual desire and the quality of a sexual contact. It is of great clinical value for sexual medicine to understand interactions between the quality of sexual contacts and hormonal secretion patterns because orgasm is one of the main determining factors for the quality of an intimate relationship.

It is well known that stress may lead to PRL increases [35,36]. However, the method used in the current study for blood sampling to determine PRL values has been applied in previous studies and proved to be reliable [17,18]. More crucially, the women in the control condition (i.e., without any sexual contact during the study time), did not show any significant PRL surge, despite the same stress of blood sampling. Therefore PRL surges are a consequence of sexual intercourse orgasm. Furthermore, all women included in the study had a regular 28-day menstrual cycle, and showed an LH surge as the first step toward ovulation, i.e., a well functioning cycle, so that differences of PRL surges cannot be attributed to menstrual cycle abnormalities.

One of the underlying physiological mechanisms of the post-orgasmic prolactin surge might be the known increase of oxytocin throughout sexual arousal with a peak during orgasm [37–40]. One case report showed a positive effect of exogenous peripheral oxytocin exposure on sexual satisfaction [41]. However, it currently remains unclear, whether this effect is caused by central or by peripheral mechanisms [37], whether PRL is involved or only oxytocin [23]. In animals, excess PRL may directly inhibit the smooth muscle relaxation of the corpus cavernosum of the penis resulting in a reduction of penile tumescence and eventually the same mechanism is valid for the clitoris and the vagina [34]. Con-

sequently, in addition to its central effects PRL might have a peripheral effect on the clitoris and the vagina.

Strengths of the study are the high internal and external validity relying on a relatively homogenous study group, control of the cycle phase and contraception method, the comparison of orgasmic and anorgasmic women, the natural field setting and the prospective study design. In addition, we demonstrated that controlling for number of orgasms is of importance. However, due to the limited size of the cohort investigated, confirmation of these results in a larger study group is suggested before these findings can definitely be translated into the clinical setting. Because the results are based on a limited number of participants, additional studies can be conducted to replicate and extend the present findings. Of note, the observed associations were very strong (of very large statistical effect size). As all study participants considered orgasm highly important for their sexual satisfaction, no group comparisons between women giving orgasm a higher/lower importance could be performed.

Conclusion

We have shown that intercourse orgasm induced PRL changes correlate strongly with the quality of orgasm and subsequent sexual satisfaction in women. The knowledge of such correlations may provide the opportunity to develop new strategies for the research and treatment of sexual disorders in women.

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