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Lower sexual interest in postpartum women: Relationship to amygdala activation and intranasal oxytocin

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ABSTRACT

During the postpartum period, women experience significant changes in their neuroendocrine profiles and social behavior compared to before pregnancy. A common experience with motherhood is a decrease in sexual desire. Although the lifestyle and peripheral physiological changes associated with parturition might decrease a woman's sexual interest, we hypothesized that there are also hormone-mediated changes in women's neural response to sexual and infant stimuli with altered reproductive priorities. We predicted that amygdala activation to sexually arousing stimuli would be suppressed in postpartum versus nulliparous women, and altered with intranasal oxytocin administration. To test this, we measured amygdala activation using fMRI in response to sexually arousing pictures, infant pictures, and neutral pictures in 29 postpartum and 30 nulliparous women. Half of the women received a dose of exogenous oxytocin before scanning. As predicted, nulliparous women subjectively rated sexual pictures to be more arousing, and infant pictures to be less arousing, than did postpartum women. However, nulliparous women receiving the nasal oxytocin spray rated the infant photos as arousing as did postpartum women. Right amygdala activation was lower in postpartum versus nulliparous women in response to sexual, infant, and neutral images, suggesting a generalized decrease in right amygdala responsiveness to arousing images with parturition. There was no difference in right amygdala activation with nasal spray application. Postpartum women therefore appear to experience a decrease in sexual interest possibly as a feature of a more generalized decrease in amygdala responsiveness to arousing stimuli.

Introduction

During the postpartum period women frequently report decreases in sexual desire (Botros et al., 2006; De Judicibus and McCabe, 2002; Fischman et al., 1986; Glazener, 1997) and to a more variable extent physiological sexual function (Baksu et al., 2006; Connolly et al., 2005). Postpartum loss of sexual desire is reported across many studies in the first six months postpartum in roughly a third to a half of women (Abdool et al., 2009; Barrett et al., 2000) and has been reported to last as long as one year (Pertot, 1981; Pastore et al., 2007) to many years following child birth (Botros et al., 2006). The pattern of findings for sexual function as measured by resumption of intercourse and pain with intercourse shows a different pattern following parturition than self-reports of desire. Generally, by six months postpartum most women have resumed sexual intercourse (Connolly et al., 2005; De Judicibus and McCabe, 2002; Hyde et al., 1996) and report orgasm function comparable to before pregnancy (Connolly et al., 2005) even though reports of dyspareunia are quite common in the first six months postpartum (Barrett et al., 2000). The literature to date suggests that physical changes and symptoms during the first six months postpartum, including incontinence, prolapse, and pain, may not be the only, or even most significant, source of decreased sexual interest in women as compared to psychological factors (Botros et al., 2006; De Judicibus and McCabe, 2002; Pertot, 1981).

There are significant neuroendocrinological changes with parturition promoting optimal maternal care that may decrease sexual interest during the first six months to one year postpartum. Neuroimaging work suggests that there are changes in the prefrontal–limbic system, including the amygdala, with motherhood to increase maternal responsiveness to infants (Leibenluft et al., 2004; Lorberbaum et al., 1999, 2002; Seifritz et al., 2003; Swain et al., 2007; Swain, 2008). Given the role of the amygdala in both sexual behavior (Karama et al., 2002; Hamann et al., 2004) and maternal behavior, as well as general emotion and

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reward processing, we hypothesized that in postpartum women the amygdala would be less responsive to sexual images and more responsive to infant images.

The post-partum period is a reproductive event with unique neuroendocrine characteristics and motivations. Although the mechanisms underlying the postpartum changes in neural and behavioral responses are not entirely clear, the neuropeptide oxytocin is thought to play an important role in postpartum women's heightened infant responsiveness and decreased response to non-infant stimuli (Carter et al., 2007; Galbally et al., 2011; Mortimer, 2008). Breast-feeding, which raises oxytocin levels (Altemus, 1995; Carter et al., 2007; Drewett et al., 1982) has been associated with a reduction in postpartum women's sexual desire and frequency of intercourse (Avery et al., 2000; Forster et al., 1994; Glazener, 1997; Hyde et al., 1996). Although oxytocin facilitates peripheral sexual arousal (Salonia et al., 2005), is elevated when sexual arousal does occur (Carmichael et al., 1987) and increases with orgasm (Blaicher et al., 1999), it is not thought to be a direct driver of sexual motivation and desire that precedes the initiation of sexual behavior (Carter, 1992; Pfaus and Scepkowski, 2005; Pfaus, 2009). This is consistent with self-report questionnaire data suggesting that postpartum women seem to enjoy intercourse and experience orgasm when intercourse occurs (Connolly et al., 2005), though they may not desire or initiate it (Woranitat and Taneepanichskul, 2007). Together, this work demonstrates both positive and negative associations of oxytocin with sexual behavior, seemingly varying based on whether the sexual behavior examined is appetitive or consummatory. The current study will examine differences in possible appetitive sexual behavior with parturition and whether there is a causal role for oxytocin in its inhibition.

Studies administering nasal oxytocin to men and nulliparous women further support a role for this hormone in amygdala responsiveness to social stimuli. Oxytocin administration has been associated with decreased amygdala activation in men in response to emotional faces (Domes et al., 2007; Kirsch et al., 2005; Meyer-Lindenberg et al., 2011) as well as increased amygdala activation in women in response to fearful faces (Domes et al., 2010). The authors of the latter study (Domes et al., 2010) argue that increased amygdala activation to oxytocin might facilitate child protection due to the sensitization towards possible threat. In women, therefore oxytocin may be associated with both an increase in amygdala activation to relevant infant stimuli, and a decrease in activation to irrelevant stimuli in the environment, including sexual stimuli. Therefore, in the current study we test the hypothesis that the proposed changes in amygdala activation in response to infant and sexual stimuli are due to specific inhibitory influences of oxytocin on women's responses to sexual images.

This study aimed to characterize neural activation typical of postpartum women in response to sexually explicit and infant images and examine whether oxytocin is related to amygdala activity in response to these stimuli. We expected postpartum women to report lower arousal to sexual images and increased arousal to infant images. We also expected a lower amygdala response compared to nulliparous women in response to sexually arousing pictures and higher amygdala activation in response to infant images. Differences between nulliparous and postpartum women in both self-reported arousal and amygdala activation were expected to be attenuated with exogenous oxytocin nasal spray.

Methods

Participants

Participants were 30 nulliparous and 29 postpartum women recruited through flyers, emails, and local organizations. We included only heterosexual women currently in relationships, aged 20–40, and not pregnant. The majority of participants self-reported as White (47; 22 nulliparous), six were Asian (4 nulliparous), three were Black (all nulliparous), one was Hispanic/Latino (postpartum), and two participants self-described themselves as 'Other' (1 nulliparous). The majority of women (26) reported an education level at the Bachelor's degree level, 17 reported completing up to high school (8 postpartum), and 16 had post-graduate degrees (11 postpartum). Average age of participants was 27 years old, however nulliparous women were significantly younger than postpartum women (Mean ± SD nulliparous = 23.8 ± 3.74, Mean ± SD postpartum = 30.21 ± 4.44, $p \leq .001$). All women self-reported their health as 'Good' or 'Excellent' and there was no significant difference across groups. Women reported an average 7 hours of sleep a night, as measured as self-reported hours asleep the previous night (excluding interruptions), with no significant difference between nulliparous and postpartum women (Table 1). We did observe a significant difference in weight ($p = .04$) and percent body fat ($p = .001$) in which postpartum women were higher (weight, Mean ± SD nulliparous = 138.21 ± 27.26, Mean ± SD postpartum = 153.72 ± 26.04; Percent body fat, Mean ± SD nulliparous = 25.84 ± 7.76, Mean ± SD postpartum = 33.82 ± 8.89). None of the variables discussed above differed significantly by nasal spray assignment group. All women reported high satisfaction with their partners in terms of their relationship (Scale 1–5, 1 = very satisfied, *Mean* ± *SD* = 1.4 ± .5) and partner's help with childcare (*Mean* ± *SD* = 1.34 ± .48).

Postpartum respondents were eligible only if they had an infant aged 3–6 months at the time of testing (*Mean weeks* ± *SD* = 21.30 ± 6.13; No difference by spray group) and were primarily breast-feeding their infant (>75% breast-feeding), in order to reduce potential confounds between bottle and breast-feeding women who may have different neuroendocrine states. All postpartum women were breast-feeding primarily (average percent breast-feeding, *Mean* ± *SD* = 87% ± 17.55). Sixteen of postpartum women were primiparous (Mean # children = 1.76 ± 1.15). Ten of the postpartum women reported currently using hormonal contraceptives, none of the nulliparous women did. Within postpartum women, eight women reported having resumed menstruation, 21 had not. Differences in contraceptive use and menstruation status did not impact the pattern of findings reported here.

Participants were assigned to either the placebo or oxytocin nasal spray group in a double blind procedure. Because depression is associated with altered neural responses to emotional stimuli (Siegle et al., 2007), we only included nondepressed women. Screening was done with The Edinburgh Postnatal Depression Scale (Cox et al., 1987;

Table 1
Mean scores (±std. dev) by cohort on the BISF-W, mood, and sleep. Nulliparous women had significantly higher scores for all BISF-W dimensions except D7. There were no differences in measures of anxiety, depression, or sleep.

	Nulliparous (N = 27)	Postpartum (N = 24)	Total (N = 51)
BISF-W			
D1 thoughts/desires (range 0–12) ***	7.71 ± 2.23	5.13 ± 2.20	6.49 ± 2.55
D2 arousal (range 0–12) ***	8.23 ± 2.33	5.49 ± 2.40	6.94 ± 2.72
D3 frequency (range 0–12)***	5.69 ± 1.89	3.20 ± 1.31	4.52 ± 2.05
D4 receptivity/initiation (range 0–15) *	9.70 ± 2.71	7.88 ± 3.55	8.84 ± 3.24
D5 pleasure/orgasm (range 0–12) ***	6.51 ± 1.48	4.03 ± 2.07	5.34 ± 2.16
D6 relationship satisfaction (range 0–12) **	10.52 ± 1.60	7.92 ± 2.50	9.29 ± 2.44
D7 problems affecting sex (range 0–16)	2.72 ± 1.59	4.97 ± 2.10	3.78 ± 2.15
Composite score (range −16 to 75) ***	45.65 ± 8.51	28.66 ± 11.27	37.66 ± 13.02
Anxiety (range 0–7)	.32 ± .55	.25 ± .44	.29 ± .49
Depression (EPDS)	5.42 ± 4.51	4.24 ± 2.36	4.78 ± 3.51
Sleep (hours)	7.24 ± 1.46	7.45 ± 1.53	7.34 ± 1.48

Significant difference across cohorts $^{*}p \leq 05$; $^{**}p \leq 01$; $^{***}p \leq .001$