Reprinted from **The Amygdala in Brain Function**
Volume 985 of the *Annals of the New York Academy of Sciences*
April 2003

Medial Amygdala Regulates Mating-Induced Dopamine Release in Medial Preoptic Area

JUAN M. DOMINGUEZ AND ELAINE M. HULL

Department of Psychology, University at Buffalo, State University of New York, Buffalo, New York 14260, USA

KEYWORDS: **medial amygdala; dopamine; medial preoptic area; mating**

The medial preoptic area (MPOA) is an important regulator of male sexual behavior. Dopamine facilitates copulation in many species. Microinjections of dopamine agonists into the MPOA facilitate, and antagonists impair, male sexual behavior.[1] Extracellular dopamine increases in the MPOA of male rats during precopulatory exposure to an estrous female and during copulation.[1] A major source of input to the MPOA is the medial amygdala (MeA). The MeA receives input from the olfactory bulbs and vomeronasal organ; it processes and relays this information to the MPOA and other sites.[2] MeA lesions impair copulation[2] and block the increase in noncontact erections[3] and facilitation of copulation[4] that result from exposure to an inaccessible estrous female. Finally, androgen implants in the MeA restore some measures of sexual behavior in castrates.[1] Here, we review recent reports by our laboratory, showing that MeA lesions blocked the mating-induced release of dopamine in the MPOA and that chemical stimulation of the MeA enhanced extracellular dopamine in the MPOA of male rats.

METHODS

Experiment 1

Sexually experienced males were anesthetized and received bilateral radiofrequency lesions or sham lesions of the MeA and guide cannulas aimed at the MPOA for microdialysis. After 14 days, dialysis probes were inserted. After 5 hours, baseline samples were collected. An estrous female was then placed in a wire cage above the male. Finally, the animals copulated for 30 minutes. Behaviors were recorded, and dialysis samples were collected every 6 minutes. Samples were assayed using high-performance liquid chromatography with electrochemical detection (HPLC-EC).

Address for correspondence: Elaine M. Hull, Ph.D., Department of Psychology, University at Buffalo, State University of New York, Park Hall, Box 604110, Buffalo, NY 14260-4110. Voice: 716-645-3650, ext. 671; fax: 716-645-3801.
emhull@buffalo.edu

Ann. N.Y. Acad. Sci. 985: 515–518 (2003).

Experiment 2

Urethane-anesthetized male rats received ipsilateral microdialysis probes in the MPOA and cannulas above the MeA for microinjections. After 5 hours, baseline dialysis samples were collected, and glutamate and L-trans-2,4-PDC (glutamate uptake inhibitor) were then coinjected into the MeA for stimulation. Six more samples were then collected from the MPOA. Samples were assayed as above.

RESULTS AND DISCUSSION

In Experiment 1, MeA lesions impaired copulation (FIG. 1). Males with MeA lesions had fewer ejaculations, required more time and intromissions to achieve ejaculation, and required more time to reinitiate copulation after ejaculating. Moreover, MeA lesions also blocked the mating-induced increase in extracellular MPOA-dopamine (DA) seen in animals with sham lesions (FIG. 2). In Experiment 2, chemical stimulation of the MeA increased extracellular dopamine in the MPOA (FIG. 3).

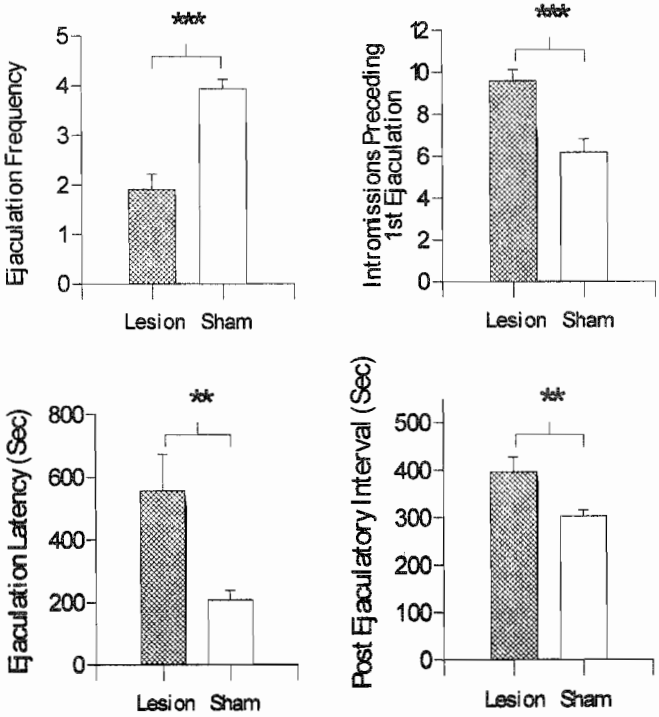

FIGURE 1. Medial amygdala (MeA) lesions impaired copulation, compared to shams. Each value is the mean ± SEM ($^{**}P < 0.01$; $^{***}P < 0.001$). Reprinted from Dominguez *et al.*[5] with permission. Copyright 2001 by the Society for Neuroscience.

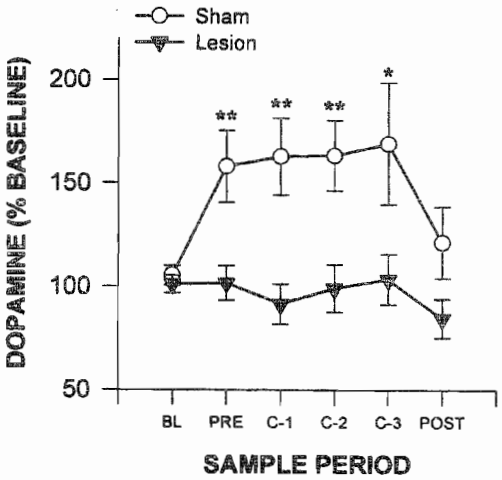

FIGURE 2. Extracellular dopamine in the medial preoptic area (MPOA) of controls increased during the precopulatory period (PRE) and copulatory periods (C-1, C-2, and C-3), but decreased to near baseline during the postcopulatory period (POST). Extracellular dopamine did not change significantly in rats with medial amygdala (MeA) lesions. BL, baseline. Each value is the mean ± SEM ($^{*}P < 0.05$; $^{**}P < 0.01$). Reprinted from Dominguez *et al.*[5] with permission. Copyright 2001 by the Society for Neuroscience.

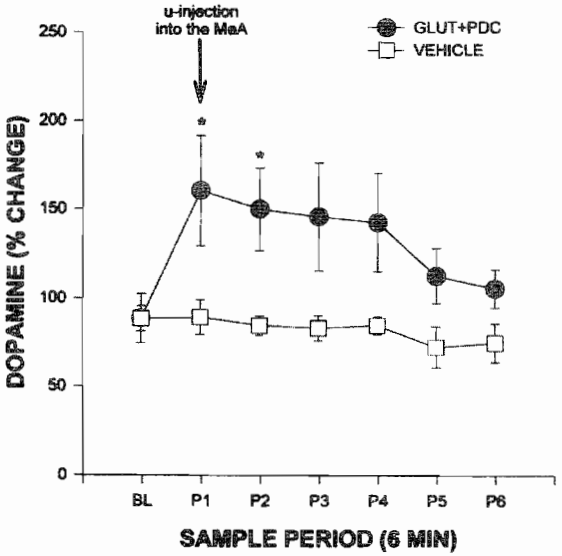

FIGURE 3. Extracellular dopamine in the medial preoptic area (MPOA) increased after medial amygdala (MeA) chemical stimulation, but not after vehicle microinjections. Each value is the mean ± SEM ($^{*}P < 0.05$). Reprinted from Dominguez *et al.*[6] with permission. Copyright 2001 by Elsevier Press.

In these experiments, lesions of the MeA impaired copulation and inhibited mating-induced dopamine release in the MPOA, which normally facilitates male sexual behavior.[1] In addition, chemical stimulation of the MeA increased extracellular dopamine in the MPOA. Together, these data suggest that increased dopamine release in the MPOA during exposure to an estrous female and during copulation is mediated, at least in part, by the MeA, which is important for the integration of sexually exciting chemosensory input and for androgen's facilitation of male sexual behavior.

REFERENCES

1. HULL, E.M., R.L. MEISEL & B.D. SACHS. 2002. Male sexual behavior. *In* Hormones, Brain, and Behavior. D.W. Pfaff, Ed. :3–137. Academic Press. San Diego, CA.
2. NEWMAN, S.W. 1999. The medial extended amygdala in male reproductive behavior: a node in the mammalian social behavior network. Ann. N.Y. Acad. Sci. **877:** 242–257.
3. KONDO, Y., P.G. JORDAN & B.D. SACHS. 1999. Small medial amygdala lesions prevent noncontact erection in rats without impairing copulation or partner preference. Soc. Neurosci. Abstr. **25:** 345.
4. DE JONGE, F.H., W.P. OLDENBURGER, A.L. LOUWERSE & N.E. VAN DE POLL. 1992. Changes in male copulatory behavior after sexual exciting stimuli: effects of medial amygdala lesions. Physiol Behav. **52:** 327–332.
5. DOMINGUEZ, J., J.V. RIOLO, Z. XU & E.M. HULL. 2001. Regulation by the medial amygdala of copulation and medial preoptic dopamine release. J. Neurosci. **21:** 349–355.
6. DOMINGUEZ, J.M. & E.M. HULL. 2001. Stimulation of the medial amygdala enhances medial preoptic dopamine release: implications for male rat sexual behavior. Brain Res. **917:** 225–229.