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Physiological correlates of self-injurious behavior in captive, socially-reared rhesus monkeys

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Abstract

This study examined the relationship between self-injurious behavior (SIB) in rhesus monkeys and several biological variables, including monoamine metabolites in cerebrospinal fluid (CSF) and circulating levels of ACTH, cortisol, and testosterone. Cisternal CSF and blood plasma samples were obtained from 23 individually housed male rhesus macaques, 14 of which had a veterinary record of self-inflicted wounding. CSF samples were analyzed for 5-hydroxyindole-3-acetic acid (5-HIAA), homovanillic acid (HVA) and 3-methoxy-4-hydroxyphenylglycol (MHPG) using isocratic high-performance liquid chromatography with electrochemical detection (HPLC-EC). Plasma samples were analyzed for ACTH, cortisol, and testosterone using commercially available radioimmunoassays (RIAs). Rates of self-directed biting were determined by systematic observation of all monkeys. Monkeys with SIB did not differ from controls in their basal monoamine or gonadal activity. However, the SIB group showed consistently lower mean plasma cortisol levels than the control group. Plasma cortisol was negatively correlated with rates of self-directed biting. These results suggest a persistent dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis in monkeys with SIB. It is not yet clear whether this phenomenon of low cortisol represents chronically reduced adrenocortical secretion under basal conditions or a difference in response to the mild stress of capture and chemical restraint. The implications of these findings will be discussed with respect to

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SIB in humans as well as post-traumatic stress disorder (PTSD), a condition characterized by pituitary–adrenocortical hypoactivity. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

A small but persistent percentage of nonhuman primates housed in biomedical research facilities develops pathological behavior. In rhesus monkeys, this pathology takes the form of self-injurious behavior (SIB) consisting of repetitive self-directed biting that can result in tissue damage and mutilation (Bayne et al., 1995; Novak et al., 1998). Assessment of colony and medical records at the New England Regional Primate Research Center (NERPRC) indicates that SIB is quite variable in expression (Jorgensen et al., 1998). Wounding is relatively rare. However, monkeys with a wounding history typically engage in some form of self-directed biting on a daily basis. In some monkeys, this activity is brief, consisting of a single bite, whereas in others, the biting episode consists of a frenzied, ritualized sequence of multiple bites lasting several seconds or more. Rhesus monkeys at NERPRC do not engage in other forms of potentially self-injurious behavior, such as self-hitting, head-banging or eye-gouging, that have been reported for isolation-reared animals (Kraemer et al., 1997).

Self-injurious behavior in monkeys can be considered from several different perspectives. First, we can view this behavior as a model of human SIB, a behavior that occurs in certain clinical populations (for example, patients with developmental disabilities or suffering from borderline personality disorder), but is also increasingly prevalent in the general population (Favazza, 1998). Second, SIB in monkeys can be approached from the perspective of colony management, as animals exhibiting this behavioral pathology are often unsuitable for research use. The third perspective involves an attempt to understand the etiology and underlying pathophysiology of SIB. This last perspective provides the foundation of the research reported in the present paper.

Two environmental conditions have been implicated in the development of SIB in monkeys. These are: 1) isolation rearing, wherein infant monkeys are separated from their mothers at birth and raised under severe social deprivation (Fittinghoff et al., 1974; Mason, 1968; Sackett, 1968), and 2) individual cage housing of socially reared juvenile and adult monkeys (Bayne et al., 1992; Paulk et al., 1977). Although both conditions involve social separation, they typically have profoundly different consequences because the separation occurs at different points in the animal's life. It should be noted that isolation rearing cannot account for the occurrence of SIB in contemporary research settings inasmuch as infant monkeys are seldom reared without social companionship.

Alterations in several physiological systems have been hypothesized to influence the expression of SIB in monkeys. Putative neurochemical involvement includes the central serotonergic (5-HT) (Kraemer and Clarke, 1990; Kraemer et al., 1997; Weld et al., 1998), dopaminergic (DA) (Goldstein, 1989; Lewis et al., 1990), and norad-

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