Plasma Androgens and the Sex Offender

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Introduction

In recent years, the study of human behavior has been greatly enriched by advances in the biologic and physiologic sciences and the concomitant development of organic methods, especially drugs, to alter and to treat cognitive, affective, and behavior disorders. In particular, recent refinements in the techniques for measuring plasma hormone levels have prompted increased interest in the psychoendocrinology of behavior, including sexual disorders and the paraphilias.1 The purpose of this paper is to briefly summarize new developments in the psychoendocrinology of sexual and aggressive behavior, to present findings from two studies of androgens in rapists and child molesters, and to highlight several new and promising areas of research.

Historical Perspective

The search for psychoendocrine correlates of behavior, including criminal activity, is not new. In his presidential address to the American Psychiatric Association in 1898, R. M. Bucke suggested that the newly discovered internal secretions of the ovary could become a toxic agent of unknown but great virulence and suggested this as an etiologic factor in certain female mental disorders. In 1924 Schlapp discussed behavior and gland disease and stated that it would not surprise him if investigators were to reveal that a third of all convicts at that time were sufferers from gland or toxic disturbances. In 1932 Berman presented data on prisoners in Sing Sing which, in his opinion, indicated a direct relationship between deficiency and imbalance of the endocrine glands and criminal activity. Subsequently, during the 1930's, Wright was one of the first to specifically study endocrinopathies in sex offenders. Estrogen, androgen, and gonadotropin levels were determined by urine assay technique. His studies focused primarily on endocrinologic aspects of homosexuals and homosexual sex offenders, but also included several cases of exhibitionism. He indicated that he was not aware of any biological study of violent sex offenders.

After these initial reports, studies of the psychoendocrinology of sex offenders was limited to occasional scattered reports on organic treatment using various drugs and hormones purported to influence

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sexual interest or performance, including phenothiazines, testosterone propionate, estrogens, stilbesterol, and, more recently, medroxyprogesterone.6-11

Within the last fifteen years, more precise techniques for the determination of plasma levels of gonadal hormones, particularly testosterone, have resulted in a marked increase in studies of animal and human subjects. What follows is a summary of those studies which are pertinent to clinicians involved in the diagnosis and treatment of sexual dysfunctions and sex offenders.

**Plasma Androgens and Sexual Behavior**

Inherently, both the brain and the reproductive system are female; their development along sexually dimorphic lines depends upon exposure to gonadal hormones at a critical period.12 Thus, androgens in utero crucially influence the development of male sexual structures. Following birth, plasma testosterone levels are elevated in both sexes and then fall to a low level in both sexes until puberty, when there is a gradual rise in the male. After puberty the mean male plasma testosterone level is approximately ten times the circulating female plasma testosterone level. Testosterone is the hormone of libido in both males and females.13,14 There is a fall in plasma testosterone level with advancing age, but when this fall begins is not known with precision and appears to be influenced by a variety of factors including the general health of the person.15 There is, however, also a fall in the clearance rate from the plasma that suggests that normally sensitive tissues are utilizing less testosterone. The endocrine function of the testes can be summarized as follows: 1) the synthesis and secretion of testosterone is the single important function of the Leydig cell of the testes; 2) there is no evidence that the testes secrete any steroids other than testosterone in amounts sufficient for significant biological effects; and 3) testosterone is the single most important plasma androgen.16

A number of investigators have reported studies on the relationship between plasma testosterone levels and human sexual activity. Fox et al.17 reported a prolonged study relating plasma testosterone levels to coitus in one male subject in whom plasma testosterone levels taken during and immediately after sexual intercourse were significantly higher than those found under resting conditions. Subsequent reports18,19 have failed to find postcoital increases in FSH, LH, or testosterone levels in men. At present there is no firm evidence that gonadotropins or testosterone respond significantly to sexual activity in men.

Of particular clinical interest is the question of the relationship between plasma testosterone and the form and object of sexual expression. In recent years, such studies have focused on the relationship between homosexual behavior and plasma testosterone in male homosexuals. Kolodny et al.20 measured plasma testosterone and semen
analysis in male homosexuals. Thirty male homosexual students between the ages of eighteen and twenty-four were interviewed and classified according to degree of homosexuality. Physical examination, plasma testosterone determinations, semen analysis, and buccal smears were performed. Physical examinations and buccal smears gave normal results. Plasma testosterone levels for groups of exclusively or almost exclusively homosexual males were significantly below testosterone levels for a control group of heterosexual males. Analysis of variance showed a significant difference in sperm counts according to degree of homosexuality. There was a high correlation between sperm counts and plasma testosterone concentration. One major criticism of the study is that a significant number of the men demonstrated azoospermia or oligospermia. Since azoospermia or oligospermia is not a characteristic of homosexuality per se, it has been suggested that the sample was not in fact random.

Shortly thereafter, a number of reports disputed the findings of Kolodny et al. Birk et al. measured testosterone levels in nineteen homosexuals and found a normal range and mean given their laboratory values. Parks et al. studied twenty-eight consecutive daily determinations of FSH, LH, and testosterone in six adolescent male homosexuals and six male heterosexuals matched for bone age and pubertal stage. All values for FSH, LH, and testosterone were within normal limits for both bone age and pubertal development. The hormonal levels of homosexuals did not differ significantly from those of the heterosexuals.

Tourney and Hatfield found normal plasma dehydroepiandrosterone, etiocholanolone, and testosterone levels in thirteen homosexual subjects. Doerr et al. also studied plasma testosterone, estradiol, and semen analysis in male homosexuals. The degree of homosexuality in thirty-two homosexuals was ascertained by use of the hetero-homosexual rating scale of Kinsey. A control group of fifty-six normal adult males was used for the sex hormone determinations and another similar control group for semen analysis. Plasma estradiol concentrations of the homosexual group were elevated, and it was concluded that elevated plasma estradiol concentrations are a biological feature of this group and may be associated with the homosexual behavior. Plasma testosterone determination and semen analysis did not reveal any significant differences between the homosexual and the two control groups. Friedman et al. studied twenty homosexual and eighteen heterosexual subjects. They reported no significant differences between the two subject groups on testosterone, estradiol, or estrone. Newmark et al. recently evaluated the gonadotropin-testosterone-estradiol profiles of four homosexual men and four heterosexual men by a multiple-sampling technique. Although there was extensive overlap between the two groups, the homosexual subjects had higher estradiol levels than the heterosexuals and lower FSH values. Testosterone and luteinizing hormone levels were comparable in the two groups. These
observations suggest that there may be subtle differences in gonadotropin and estradiol secretion in homosexual subjects that can be detected only by repeated sampling.

Finally, Brodie et al.\textsuperscript{27} reported on nineteen homosexual males and found that the mean testosterone level was in the normal range but the mean for the homosexuals was significantly higher than for normals. Similarly, Gartrell et al.\textsuperscript{28} measured plasma testosterone levels in twenty-one homosexual women and nineteen age-matched heterosexual women. Although values for the two groups overlapped considerably, testosterone concentrations averaged thirty-eight percent higher in homosexual than in heterosexual subjects.

I have presented the data on homosexual subjects in some detail because they give an excellent example of the difficulties involved in conducting and interpreting studies measuring correlations between hormone levels and specific behavior patterns in humans. At this point, there is no evidence indicating an association between the form and object of sexual expression and plasma testosterone in human subjects.

**Plasma Androgens and Aggressive Behavior**

We turn now to the question of the relationship between plasma testosterone and aggressive behavior. This topic is germane to a discussion of sex offenders because certain sex offenders and certain sex offenses are characteristically more violent and aggressive than others.

A large number of studies of testosterone and aggressive behavior have been reported in animals of many species.\textsuperscript{29-31} In general, these studies indicate the importance of androgens in establishing a biological readiness to aggressive behavior and in facilitating the expression of aggressive behavior in adult animals. However, they also indicate the importance of social factors and learning on the actual expression of aggression in adulthood.\textsuperscript{32}

By comparison with the animal literature, few studies have reported on the association of plasma testosterone level with aggression or violence in humans. These studies have been recently reviewed in some detail.\textsuperscript{33,34}

Persky et al.\textsuperscript{35} reported a study of affect-endocrine relationships and obtained a considerable degree of specificity between feelings of hostility and activity of the pituitary LH-testicular axis. Later, Persky et al.\textsuperscript{36} determined plasma testosterone level and testosterone production in a group of eighteen healthy young men, fifteen older men, and six hospitalized dysphoric male patients. A battery of self-rating tests, including the Buss-Durkee Hostility Inventory (BDHI),\textsuperscript{37} were administered simultaneously. The production of testosterone was found to be highly correlated with a measure of aggression derived from
the BDHI in the younger men. Kreuz and Rose\textsuperscript{38} reported plasma testosterone levels, levels of fighting and verbal aggression in prison, and past criminal behavior in twenty-one young male prisoners. They found no correlation between plasma testosterone levels and the BDHI or levels of fighting in prison. However, they found that the ten prisoners with histories of more violent and aggressive crimes in adolescence had a significantly higher plasma testosterone level than the prisoners without such a history. Meyer-Bahlburg \textit{et al.}\textsuperscript{39} used a somewhat different method but were unable to replicate the findings of Persky \textit{et al.}\textsuperscript{36} In 1974, Ehrenkranz \textit{et al.}\textsuperscript{40} determined plasma testosterone levels in thirty-six male prisoners; twelve with chronic aggressive behavior (violent, aggressive acts prior to prison and aggressive behavior in prison), twelve socially dominant prisoners without a history of violent crimes, and twelve nonaggressive, nonviolent prisoners. The plasma testosterone levels and the BDHI scores were significantly higher in the twelve chronic aggressive prisoners than the other two groups, and the socially dominant group also had a significantly higher level than the nonaggressive group. Recently, Scaramella and Brown\textsuperscript{41} have reported on serum testosterone and aggressiveness in hockey players. Subjects were fourteen male university hockey players. Each of two team coaches independently rated each player on a seven item scale designed to assess a range of behaviors related to aggressiveness. While six of the seven aggressiveness items showed positive correlations with serum testosterone, only one item, response to threat, was significantly correlated. Of greater importance than the preliminary data from this study is the demonstration of the feasibility of using competitive sports as a model in which to study aggressive behavior.

In summary, a number of studies in humans and animals suggest an association between plasma testosterone and aggression. However, the interpretation of these findings is difficult for a number of reasons. First, the findings in animals may be of little relevance to the study of human aggression. Also, self-rating scales of hostility are, at present, a coarse measure and may not discriminate adequately between the feeling of aggressiveness, the subject's belief that he is aggressive, and aggressive behavior. For example, a study with psychiatric patients has shown no consistent relationship between the patient's self-assessment of aggressiveness and assessment of the patient's aggressive behavior by relatives, psychiatrists, or psychologists.\textsuperscript{42} Furthermore, our knowledge of the normal physiology of the pituitary-testicular axis remains somewhat rudimentary. We are only beginning to understand how certain factors, \textit{e.g.}, stress, age, time of day, influence plasma testosterone level. To what extent these factors also interact with complex variables such as sexual and aggressive behavior is unknown. Finally, studies indicating a correlation between plasma testosterone and aggression do not prove a cause and effect relationship.
Androgens and Sex Offenders

Given the marked recent increased interest in the relationship between plasma testosterone, sexual, and aggressive behavior, it is surprising that relatively few studies have focused on plasma androgens in sex offenders. Murray et al. reported on the endocrine status of twenty-four male sex offenders, including sixteen pedophiles, seven rapists, and one exhibitionist. Three of the offenders had testosterone levels above normal range and the others were within normal limits. Money et al. studied ten sex offenders with 46 XY genotype (mainly pedophiles) and thirteen males with the 47 XYY genotype. The plasma testosterone levels of the XY men ranged from 212 to 1170 (median, 607) ng/100 ml and those of the XYY men ranged from 384 to 995 (median, 568) ng/100 ml. These values are similar to those of normal adult males.

Our group has conducted several studies measuring plasma testosterone in violent and nonviolent sex offenders. In our first study, we measured plasma testosterone levels in fifty-two rapists and twelve child molesters who had completed the BDHI. The rapists were classified according to the degree of violence at the time of the commission of the rape. The ranges and means of the plasma testosterone level of the rapists and child molesters were within normal limits. The group of rapists who were judged to be most violent had a significantly higher mean plasma testosterone level than normals, child molesters, and other rapists in the study. Mean BDHI rating scores for rapists were significantly higher than the mean for normals, but there was no correlation between individual hostility scores and plasma testosterone levels. There was no correlation between age, race, or length of incarceration and plasma testosterone level. The highest plasma testosterone level (1236 ng/100 ml) occurred in the only offender who murdered his victim during the rape.

In order to investigate these findings further, a second study was undertaken with the purpose of comparing plasma testosterone, dehydrotestosterone, and luteinizing hormone levels in rapists and child molesters who were selected on the basis of the degree of violence used at the time of the commission of the sex offense. The details of the methodology and selection of subjects have been described elsewhere. The mean testosterone level of rapists, child molesters, violence subgroups, and institutional controls were within normal limits. The rapists did have higher testosterone levels than the child molesters but the nonviolent rapists had slightly higher testosterone levels than the violent rapists. Violent child molesters had the highest testosterone levels of all groups. Thus, rapists and violent child molesters combined had a higher plasma testosterone level than the nonviolent child molesters, although this difference did not reach statistical significance. In this study there was no relationship between scores on the BDHI and plasma testosterone levels in rapists. However, younger child molesters
had higher BDHI scores and higher testosterone levels than older child molesters. The data from this study is consistent with a number of the previous reports indicating relationships between plasma testosterone and aggressive behaviors in criminal and noncriminal populations.

**New and Developing Areas of Research**

A number of ethical and legal considerations have placed considerable constraints on studies of incarcerated aggressive and sex offenders. These factors may in large part account for the relatively few reported studies on the psychoendocrinology of offenders. Nevertheless, a number of new methodologic and theoretical developments hold promise for future investigations.

A consistent methodologic difficulty with many of the reports on human subjects involves the use of only one blood sample for determination of hormone level. It is well known that plasma hormones fluctuate over the course of the day and also that the hormones of the pituitary-testicular axis relate via a feedback mechanism which prompts changes in plasma hormone levels. Recently, a number of investigators have reported findings of plasma androgens based on multiple determinations drawn over time by use of an indwelling catheter. Such studies suggest that alterations in the usual fluctuations of the interacting hormones, e.g., LH and testosterone, may differ among certain subject groups. Furthermore, it may not be the absolute level of a hormone, e.g., testosterone, but rather fluctuations in the relationship among hormones which may influence behavioral responses. Such studies have not been performed in sex offender populations.

A particularly exciting area relates to the growing evidence of a central nervous system anatomical and functional connection between neurotransmitters and hormone production. The effects of various neurotransmitters, e.g., norepineprine and dopamine, on release and inhibition of hormone releasing factors within the hypothalamus are currently being investigated. Further clarification of these relationships may eventually lead to a fuller understanding of clinical observations such as hypersexuality of manic patients, hyposexuality of depressed patients, and the occurrence of aggressive behavior in both groups.

The association among alcoholism, alcohol, and sex offenses has been frequently reported. Many studies have shown that acute and chronic effects of alcohol lead to a fall in plasma testosterone levels. The short term effects of alcohol abuse on plasma testosterone levels are reversible; long term heavy abuse of alcohol, however, may lead to irreversible lowering of testosterone. It appears likely, therefore, that in addition to the effect of alcohol on cognitive functioning, including judgment and social conscience, long term abuse may produce changes in the physiology of sex offenders which may impact on sexual expression and behavior.
Conclusion

Recent refinements in techniques for measuring various plasma hormones have prompted increased interest in the psychoendocrinology of sexual and aggressive behavior. Despite much basic and some clinical research, however, our knowledge of the effects of androgen hormones on the forms of sexual expression and on the commission of aggressive acts remains rudimentary. While awaiting further elucidation of these relationships, clinicians are faced with a growing number of patients suffering from disordered sexual urges and behaviors.

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