CHAPTER

3

HORMONES AND SEX

The sex hormones play an important role in human sexual functioning and they are indicated as therapeutic agents in certain clinical situations.

The relationship between sex hormones and human behavior is just beginning to be clarified. In this chapter some of the emerging concepts will be reviewed. Specifically these include a consideration of the role which prenatal androgen may play in organizing later gender-specific behavior; the effects of androgen on adult male and female sexuality; and the non-sexual behavioral effects of androgen. The behavioral effects of the female hormones, estrogen and progesterone, will also be considered.

ANDROGEN

Androgen exerts a significant influence on sexual behavior and, in turn, sexual and other kinds of experiences influence the level of this hormone. The reciprocal relationships between the sex hormones and the brain account for this dynamic. Androgen exerts important effects on the sex centers and other parts of the brain, at the same time that the production
FIGURE 9: TESTOSTERONE AND THE BRAIN

Schematic representation of the reciprocal influences between testosterone and the brain. (a) is the cortex which responds to life experiences. (b) represents the hypothalamus which is intimately connected to (c) the pituitary gland which secretes follicle-stimulating hormone (FSH). This hormone regulates testosterone production by the male testes (d), and in turn, the level of testosterone profoundly affects cerebral functioning and behavior.

of this substance is cerebrally controlled by the pituitary. Figure 9 presents these relationships in schematic form.

The effects of the sex hormones on the physical development and functioning of the genital organs and also on the secondary sexual characteristics of both genders have long been understood and need not be dealt with here. However, the sex steroids also appear to have profound effects on human behavior because of their actions on the brain. The behavioral effects of sex hormones have only recently captured the attention of the scientific community and are not understood clearly as yet. However, certain concepts relevant to the understanding of human sexuality and the practice of sex therapy are emerging into focus, and some of these will be considered briefly here.

The sex hormones appear to have behavioral consequences both by
exerting organizing effects on the brain of the developing fetus and by affecting adult behavior. These two sets of influences seem to involve different issues and will therefore be considered separately.

**Prenatal Androgens**

John Money and Anke Ehrhardt have called our attention to the fact that, if left without androgen, all fetuses would develop into anatomic and behavioral females. The principle that has emerged based on both animal experiments and clinical studies on human subjects appears to be: if androgen is present at critical times of differentiation, the external genitalia and parts of the central nervous system mediating postnatal sexual (and gender specific) behavior become masculinized; if androgen is not present, or if its action is successfully blocked, the external genitalia as well as postnatal sexual behavior will be female.

In the rodent the central nervous system site which mediates gender specific behavior has been localized in the hypothalamus. Gender specific male and female behavior in these species is rather easily defined and essentially consists of maternal behavior, submissiveness and receptivity to the male in the female, and the contrasting qualities in the male—lack of maternal and nest building behavior, mounting and greater aggressiveness.

In primates, behavior is both more complex and determined experientially to a greater degree. However, experiments with the prenatal androgenization of female primates have yielded essentially similar results. Female monkeys whose mothers received androgen during pregnancy tend to behave like male juveniles in that they are more aggressive, more energetic and less easily intimidated than other females. They tend to practice mounting behavior instead of displaying the more usual female play pattern which is more sedate and timid, less competitive, receptive to mounting and interested in care and play with infants.

Not surprisingly, attempts to apply this data to human beings are controversial and unclear. The first difficulty in attempting to extrapolate from infrahuman data arises because in humans it is presumed that the experiential influences exerted by family and culture have a far greater influence on human gender specific behavior than in infrahumans. Also, the opportunities for controlled observations of the effects of prenatal androgen on subsequent behavior in human beings are extremely limited. Actually, only two sources of such data have been exploited: iatrogenic
prenatal androgenization and the genetic disorders of metabolism which alter the effective androgen-estrogen ratio of the fetus.

In an attempt to save a threatened pregnancy, many women in the 1950's (before the virilization potential of progestational compounds was recognized) were given various progestational compounds. We now know that these compounds are chemically quite similar to testosterone and presumably have similar virilizing effects both on the embryonic anlage of the genitals and on the central nervous system sex centers as well. When the girl offspring of these gestations were studied later in life, they were uniformly found to be typical "tomboys." They had a high energy level, liked competitive sports, disliked doll play and frilly clothes, were far more concerned with and fantasized about careers than babies, etc. Surprisingly, they also tended to have much higher I.Q.'s than average. Similar results were found independently in England, where a different progestational pregnancy-saving hormone (one which does not have anatomically masculinizing but only behaviorally masculinizing effects) had been employed.

Girls suffering from Turner syndrome provide a control group which indicates that the female hormones are not responsible for the tomboy behavior of the prenatally androgenized group. Turner syndrome girls have no ovaries or testes and hence have no prenatal hormonal influences except to the extent that maternal hormones influence development. These youngsters exhibit normal "little girl" behavior in that they are less energetic and competitive than boys and enjoy doll play and maternal rehearsal behavior. Similarly, youngsters who suffer from androgen insensitivity syndrome, and whose cells do not respond to androgens display the female type of behavioral patterns.

It should be emphasized that the girls whose brains had been "androgenized" when they were embryos were not homosexual in their object choice. They were exclusively heterosexual in their orientation in that they were aroused by males rather than by females. In addition their gender identity (which is thought to be determined by child rearing factors by the age of 18 months) was unambiguously female. Later they married and had children and did not report sexual problems. However, their behavior pattern reflected more energy and competitiveness, as well as deficiencies in maternal behavior rehearsal.

It has been hypothesized by Feldman and MacCulloch that a low level of fetal androgens may predispose a boy to exhibit female-like behavior tendencies postnatally. They feel that the interplay between such ten-
dencies with the environment may be an important determinant of the primary forms of male homosexuality. They reason that a low androgen-estrogen ratio, or at any rate a fetal androgen environment which, while sufficient to produce masculinization of the body, is not sufficient to masculinize the fetal brain and subsequent behavior may be a contributing factor to primary homosexuality. The boy born from such a fetal environment may be basically gentle and timid, dislike physical "rough house" play, and display maternal behavior toward dolls or babies. Consequently he is usually subject to negative interactions with his family and especially his father, who not surprisingly may be dismayed by his boy's "feminine" or "sissy" traits. The combination of the alleged low-androgen-determined behavioral tendencies with the negative family interactions then renders the boy vulnerable to the later development of homosexuality, according to this hypothesis. This formulation has recently gained some theoretical support from the studies of Dr. Ingeborg Ward, who showed that maternal stress can have a behaviorally demasculinizing effect on the male offspring. It is postulated that under stress the mother's adrenal gland produces androstenedione, a steroid which has incomplete testosterone action, but which is similar enough to compete for receptor sites in the critical areas in the brain of the developing fetus and so presumably prevents proper masculinization of the fetal brain.

The Effects of Androgen on Adult Sexual Behavior

Our understanding of the effects of androgen on adult sexual behavior and functioning rests on somewhat firmer ground than the new and highly speculative issue of the behavioral effects of the prenatal steroids. Androgen appears to have specific effects that enhance the erotic drive of both genders. This is well documented and may be considered as established fact. However, recent evidence suggests that testosterone may have effects on behavior apart from the purely sexual.

1. Androgen and Male Libido

Men who are deprived of their main supply of testosterone by castration, or whose testosterone level is low due to some illness or other cause, gradually lose their desire for and interest in sexuality and their ability to have erection. Libido and potency are lost more rapidly when anti-androgen medication is prescribed. This happens when patients suffering from certain urological disorders are given estrogenic preparations. When
cyproterone, an androgen antagonist, is administered in the treatment of compulsive sexual behavior, libido and potency disappear in three weeks. They are rapidly restored when the drug is discontinued.

2. Androgen and Female Libido

Androgen, which presumably activates cerebral sex centers, is a prerequisite for libido in women also. Testosterone is a highly effective aphrodisiac for women, probably especially when the androgen-estrogen ratio has been on the low side. The libidinal effects of androgen have for many years been clearly understood for men, but recently have been found to be equally influential on the sexual desires of women. It has been discovered that women who are deprived of all sources of androgen by surgical ablation of ovaries and adrenals lose all sexual desire, cease having erotic dreams and fantasies and cannot be sexually aroused by previously effective sexual stimulation. Recent animal studies have confirmed these findings.

On the other hand, some women given testosterone for medicinal purposes become assertive and highly aroused sexually. Moreover, in contrast with their previous pattern of being aroused only by men with whom they have an affectionate relationship, some women on exogenous androgen tend to desire sex independently of their relationship to their partner.

Androgen is sometimes useful to increase potency and libido in men, and it has also been employed in the management of low libido states of women. Its use with women is limited by its tendency to cause masculinizing side effects. The use of testosterone in sex therapy, as well as caution and contra-indications, is discussed in Chapter 15.

3. Non-Sexual Behavioral Effects of Androgen

It is clear that testosterone activates the brain to cause erotic desire and motivation and at the same time provides the chemical environment which is required for proper structure and functioning of the genital orgasm—for sperm production, erection, ejaculation, etc. However, recent evidence indicates that the behavioral effects of androgen may extend beyond the specifically erotic and also influence agnosic and territorial behavior. Dominance behavior and energy level, as well as appetite, metabolism and “aggression,” also appear to be enhanced by androgen.

Animal as well as human studies suggest that when an individual's brain is bathed in an environment which contains a high concentration of androgen (or at any rate in a high androgen-estrogen ratio), apart from
libidinal effects he or she tends to eat more, become stronger and more muscular, and act more energetically. The individual is less likely to be intimidated, more likely to enter into competitions and, most interestingly, more likely to win in these. Criminal behavior in adolescence was found in one study to correlate with high testosterone level. In contrast, a low androgen level is likely to reduce the person's level of anger, aggression and energy, make him more responsive to advent stimuli, more sensitive to odors, pain and touch, more interested in babies and in caretaking and maternal activities.*

These observations are not meant to suggest that these hormonal influences are the prime determinants of a person's behavior. Clearly, androgen-determined behavioral tendencies may be minor compared to the tremendously powerful psychic influences which govern a person's total behavior and feelings. Nevertheless such influences seem to exist and may be more important than previously suspected.

* Perhaps it is these low androgen or female qualities which led to Dr. Harlow's observation that female monkeys make much more effective "therapists" than do males for rehabilitating the frightened, withdrawn, socially inept products of his isolation rearing experiments. The warm, non-competitive female monkey "therapist" is often successful in curing her deprived patient, whereas the aggressive male monkey "therapists" tend to fail.

Psychic Influences on Androgen Secretion

The psychological state of a person influences his androgen level, which tends to fluctuate rather markedly in response to psychic and sexual stimuli. Studies of male humans and lower primates under various conditions suggest the following relationships between male testosterone secretion and experience. Sexually attractive opportunities, stimulation and activity tend to be associated with an increase of the blood testosterone level. Depression, defeat and humiliation, such as, for example, loss of a female to another male or defeat in other adversary situations, are associated with a dramatically lowered testosterone level; chronic inescapable stress, such as experienced during officer candidate training, is also associated with a significantly lowered androgen level.

In doing sexual therapy one is sensitive to such ecologic elements and assesses the nature of the patient's situation in formulating the problem. Thus, when an impotent man is under a great deal of stress, such as during a difficult business crisis or after a destructive divorce, etc., or when he seems to be suffering from depression, it is usually wise to postpone
sexual therapy for his impotence or low libido until emotional stability has been regained.

The effects of stress on female sexual hormones are not as well understood, beyond the fact that it is known that emotional crises may be associated with disturbances in the menstrual cycle in some women.

ESTROGEN AND PROGESTERONE

The effects of estrogen and progesterone on the anatomy and physiology of the female reproductive organs, on the secondary sexual characteristics, and on pregnancy, delivery and lactation are clearly understood. However, the influence of these steroids on behavior, prenatally or during adult life, is obscure and confusing. A review of the literature of both man and animal studies indicates that estrogen and progesterone may have no specific effect on sexual behavior. There is some evidence that progesterone inhibits female sexuality, possibly indirectly, to the extent that it antagonizes the actions of androgen. A drop in female sex steroids may in fact increase libido by unmasking the sexually stimulating action of testosterone which is manufactured by the adrenal glands and is thus always present in small quantities in the woman, even after menopause or surgical castration.

The Menstrual Cycle

The hormonal fluctuations of the menstrual cycle provide an opportunity to study the effects of the female reproductive hormones on behavior. The menstrual period may be conceptualized as a "minimenopause" during which the female sex hormones drop sharply for about eight days. The following hormonal changes occur during the female menstrual cycle:

The two hormones secreted by ovarian tissue, estrogen and progesterone, behave as follows:

The estrogens peak at the time of ovulation, and also show a secondary rise during the luteal phase of the cycle. They fall sharply at and during menstruation.

Progesterone, secreted by the corpus luteum, increases at the time of ovulation, and also diminishes during menstruation.
Concurrently, the two pituitary hormones which regulate the cycle behave as follows:

- LH is sharply elevated for a day or two at the time of ovulation.
- FSH is relatively constant, being reported as somewhat lower during the luteal phase.

Throughout this cycle the female androgen supply remains at a fairly constant level (± .4%) with a tiny rise near ovulation and in the luteal phase. (These fluctuations are summarized in Figure 9.)

Women differ in their libidinal responses to these hormonal fluctuations. This is not surprising because female erotic cravings are multidetermined. Some women seem to experience no special libidinal changes correlated with the menstrual cycle. However, many report feeling cyclic changes not only in sexual desire but in irritability and mood. Although there is agreement that many women experience consistent fluctuations in female sexual responsiveness during their menstrual cycles, there is controversy regarding where in the cycle the highs and the lows of female libido are to be found. O'Connor et al. have reviewed the literature on this subject and report that psychoanalytic writers, notably Thérèse Benedict and Helene Deutsch, feel that female libido begins to rise near the beginning of the cycle and peaks when estrogen levels are high. Not surprisingly, this contention is consistent with the psychoanalytic hypothesis that the high estrogen phase coinciding with ovulation is the period of highest feminine psychic integration and receptivity. Other writers, notably Udry and Morris, claim to have found a depression of libido and orgasm during the luteal phase. This depression is prevented by contraceptive medication which blocks ovulation and so eliminates the luteal phase of the cycle. These writers conclude that progesterone inhibits feminine libido.

In contrast, the other studies of fluctuations of female libido, including those of Kinsey and Masters and Johnson, indicate that for many women sexual desire and orgasm are most intense in the premenstrual, menstrual and postmenstrual periods when the estrogen and progesterone levels drop to their low ebb. This preference is striking in that it coincides with the most physically unfavorable conditions, i.e., low possibility of fertilization along with messy menstrual bleeding and discomfort.

Perimenstrual Tension Syndrome

Apart from libidinal fluctuations, the menstrual cycle is also accompanied in a substantial number of women (various authorities estimate from 25% to 100%) by significant shifts in mood, in behavior and in
psychic integration. Numerous investigators have systematically studied these fluctuations of emotional, medical, psychiatric and behavioral problems during the menstrual cycle. The results are remarkably uniform. All studies find that the incidence of a wide array of disorders in women is significantly higher during the perimenstrual phase of the cycle. Specifically the following problems occur with far greater frequency during this period: (1) mood changes—depression, paranoid feelings, irritability, anxiety; (2) behavioral disturbances motivated by mood disturbance—alcohol and drug abuse, crimes of violence, accidents, suicides and calls to suicide prevention centers; (3) illness presumably related to mood change—admission to medical, surgical and psychiatric wards, migraine headaches, gastro-intestinal disturbances, schizophrenic episodes and relapses. All the studies indicate that the maximum disturbance and the highest incidence of violence, illness and accident occur during eight consecutive days—four premenstrual and four menstrual. Another smaller peak in disturbance occurs at ovulation.

There is an obvious negative correlation between estrogen level and behavioral disturbance. The highest incidence of disturbance occurs during the phase of the menstrual period when the estrogen level is low and the small mid-cycle peak of disturbance falls at the same time as the small mid-cycle estrogen dip! The true significance of these striking correlations remains to be clarified.

Very rarely, some women report that they feel increased energy and relief of depression and become more productive during this period.

Figures 10, 11 and 12 are from John O'Connor’s recent review of Behavioral Rhythms Related to the Menstrual Cycle (in Biorhythms and Human Reproduction, Ferin, M. et al., Eds., New York, John Wiley & Sons, 1974). This period of disturbance coincides with the peak of sexual desire.

The mechanism of the menstrual tension phenomenon is not understood, although there are many hypotheses. Psychoanalytic writers tend to attribute this syndrome to neurotic sources which involve the symbolic meaning of the menstrual flow. However, it seems certain that endocrine factors are also important determinants.

An important datum which must be accounted for in any attempt to explain this phenomenon is that perimenstrual tension does not occur during non-ovulatory cycles, when no progesterone is produced because no corpus luteum is formed. In fact a severe perimenstrual tension syndrome, with significant paranoid and depressive features which do not respond favorably to psychotherapy or tranquilizer medication, is often
FIGURE 10: VARIATIONS IN ESTROGEN AND PROGESTERONE LEVELS DURING THE MENSTRUAL CYCLE.

FIGURE 11: MENSTRUAL CYCLE PHASE AND COMBINED INCIDENCE OF MORBIDITY IN A NORMAL POPULATION (As reported in the literature) (527 females): acute hospital admissions; sickness in industry; accidents.

FIGURE 12: MENSTRUAL CYCLE PHASE AND COMBINED INCIDENCE OF PSYCHOPATHOLOGIC BEHAVIOR (As reported in the literature) (812 females): psychiatric hospitalizations; suicide attempts and calls; newly convicted prisoners; disorderly prisoners.
helped by ovulation suppressive medication such as the type usually used for contraceptive purposes. This has a strikingly beneficial effect in a number of cases.

In the course of sex therapy, one may take advantage of perimenstrual increased sexual tension when treating a non-responsive woman.

Anger and the Perimenstrual Syndrome

There is one striking clinical observation which characterizes the syndrome regardless of whether the patient manifests her distress merely as a mild irritability or as a severe psychotic paranoid episode. In all these women, there seems to be a great increase in anger or aggression over their usual pattern. Some women can tolerate and integrate an increased tendency to react with anger. Other women are disorganized thereby or at any rate motivated to behave in self-destructive or other aggressive ways. Depending on their personality and defensive organization, some women externalize their rage and attack and provoke others. Other women conflicted with guilt and fear get ill, depressed, withdraw and have accidents. Creative women tend to write violent poetry or paint paintings which express anger and depression during this time.

CLINICAL APPLICATIONS

The concepts discussed in this chapter are not all immediately applicable to sex therapy. They are relevant only inasmuch as they form a part of the basic behavioral data upon which clinical practice rests. The most important concepts may be summarized thus: there is good evidence to indicate that both male and female libido and sexual responsiveness require that the brain and the genitals be supplied with adequate levels of testosterone. It follows from this that androgen therapy is clearly indicated in certain clinical conditions. The evidence that prenatal androgens play an important role in establishing male gender identity and adult male behavioral tendencies is fascinating but by no means established, and no direct clinical applications of this data have been developed thus far. Even more problematical are the effects of estrogen and progesterone on female behavior. The only clearly emergent concept one can see on this topic at present is that the drop in these two hormones which characterizes the perimenstrual and menopausal periods is accompanied in
many women by various degrees of psychological disturbance. Treatment is available for this syndrome. In the post-menopausal patient, replacement therapy with estrogenic compounds is considered to be the treatment of choice by many clinicians. Interestingly, the perimenstrual tension syndrome often, but not always, responds to contraceptive medication which stops ovulation and thereby prevents the formation of the corpus luteum, which is the primary source of progesterone. Apart from treatment of the hormone-related psychic disorders, the primary application of this material to sex therapy is that the therapist should be sensitive to and take into consideration the wife's psychic state when he is working to modify the couple's sexual interactions in a therapeutic direction.
CROSS REFERENCES AND BIBLIOGRAPHY
FOR AREA I

Suggested Cross References

In this book, the physiological concomitants of female sexual arousal and orgasm (and particularly the role of the clitoris in the production of orgasm) are discussed within a clinical framework in Section IV B on The Sexual Dysfunctions of the Female. Additional physiological data on the male sexual response are provided in Section IV A on The Sexual Dysfunctions of the Male. The biphasic nature of the sexual response is also discussed from a clinical perspective in Area IV.

Area II on Etiology discusses the many negative influences which can interfere with and inhibit the sexual response, while Area III on Treatment discusses the treatment strategies which have been developed to release the sexual response reflexes from inhibition by higher influences.

The clinical use of testosterone in treating potency and libido disorders is discussed in Chapter 15 on the erectile dysfunctions. The relationship of stress and sexual functioning is further discussed in Section II A on The Biological Determinants of the Sexual Dysfunctions, and also in Chapter 23, which deals with the sexual dysfunctions that are associated with psychiatric disorders, including depression and anxiety.

Bibliography

A more detailed description of basic sexual physiology may be found in Human Sexual Response, by Masters and Johnson (Boston: Little, Brown, 1966), while the relationship between sexual physiology and various sexual dysfunctions is described in Human Sexual Inadequacy by the same authors (Boston: Little, Brown, 1970). The “Mechanism of Erection” is reviewed by Howard D. Weiss in the journal, Medical Aspects of Human Sexuality, February 1973.

Mary Jane Sherfey has provided an excellent description of the anatomy of the male and female sexual organs in The Nature and Evolution of Female Sexuality (New York: Random House, 1972). This volume also includes an interesting discussion of the comparative embryological development of the male and female reproductive organs, as well as a controversial hypothesis regarding the power of female sexuality and its influence on society.


A good basic text on neuroanatomy, which also explains some principles of neurophysiology, is Functional Neuroanatomy by W. J. S. Krieg (New York: Blakiston, 1953). The Understanding of the Brain by J. C. Eccles (New York: McGraw-Hill, 1973) is a more advanced work on neurophysiology.
The work of Paul MacLean, which was described in this Area, may be found in "New Finding Relevant to the Evolution of Psychosexual Functions of the Brain" in *J. Nerv. and Ment. Dis.*, Vol. 135, no. 4, 289-301, 1962. Further information on the limbic system can be found in "The Limbic System with Respect to Self-Preservation and the Preservation of the Species" in *J. Nerv. and Ment. Dis.*, Vol. 127, no. 1, 1-11, 1958, while more information on the cerebral localization of ejaculation and erection respectively which supports the biphasic concept of the sexual response was published in "Further Studies on Cerebral Representation of Penile Erection: Caudal Thalamus, Midbrain and Pons" in *J. of Neurophysiology*, Vol. 26, no. 2, 273-293, 1963, and "Cerebral Localization for Scratching and Seminal Discharge" in *Arch. of Neuro.*, Vol. 9, 485-497, 1963, also by MacLean and others.

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Some new findings of the effects of sexual activity on fluctuating testosterone levels in the male were published by C. A. Fox et al. in "Studies on the Relationship between Plasma Testosterone Levels and Human Sexual Activity" in *J. Endocr.*, Vol. 52, 51–58, Jan. 1972. The publications of Ursula Laschet which include "Die Anwendbarkeit von Antiandrogen in der Humanmedizin" in *Saarlandisches Arzteblatt*, 1969, discuss the effects of antiandrogen medication on human subjects. The classic study which first confirmed the importance of androgen in female sexuality was by M. G. Drellich and S. E. Waxenberg in *Science and Psychoanalysis*, J. Masserman, Ed. (New York: Grune & Stratton, 1966).

The complex subject of the effects of the menstrual cycle fluctuations of estrogen and progesterone on female libido and on other aspects of behavior has recently been reviewed in an article by John O'Connor et al. in "Behavioral Rhythms Related to the Menstrual Cycle" which will appear in *Biorhythms and Human Reproduction* (New York: Wiley, 1974).

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*"The Use of Antiandrogens in Human Medicine"*