Endo

DISORDERS OF SEXUAL FUNCTION

Jean D. Wilson, M.D.
Parkland Memorial Hospital
Medical Grand Rounds
March 1, 1984

INTRODUCTION

Sexuality, in broad terms, consists of those physiological, anatomical, and behavioral functions that support or effect the union of male and female gametes and thus ensure continuation of the species. The focus of this discussion is upon sexual function in a narrow perspective - desire, arousal, ejaculation, and orgasm - and on clinical dysfunction of these parameters including such conditions as impotence, failure of ejaculation, dyspareunia, and anorgasmia.

Because of the complexity of the neurogenic reflexes and of the endocrine control systems involved, sexual dysfunction is exceedingly common. Indeed, in men occasional impotence occurs at all ages, and by age 65 a fourth of men have experienced erectile failure (1). The frequency of sexual dysfunction in women is probably equally common. Only a portion of the abnormalities have an organic basis, the remainder being functional or psychogenic in character (2). There is no arena of medicine in which psychological factors interdigitate more closely with endocrinology than in sexual function. From the standpoint of clinical medicine, the primary objective is to delineate the organic causes of sexual dysfunction and to devise appropriate endocrine, pharmacological, or surgical therapy for those cases that have an organic basis. It should always be kept in mind, furthermore, that counseling (and treatment) of psychogenic causes of sexual dysfunction can frequently best be handled by the physician who takes an interest in the problem rather than by a psychiatrist or sex therapist.

Investigation of the physiology of normal and abnormal sexual function lagged behind most aspects of applied physiology because of a paucity of adequate technical means to quantify states of sexual arousal. In large part this deficit has been repaired by the development of a variety of techniques for measuring blood flow to the genitalia and by the application of the techniques of modern molecular pharmacology to sexual studies. As a consequence, there is now considerable insight into the neurogenic, vascular, and muscular actions involved and into the mechanisms by which hormones integrate and control the process. The sexual response of the male has been studied more extensively than that of the female, but on the basis of the available evidence, it is likely that the two processes are fundamentally similar.

MALE SEXUAL RESPONSE

The Penile Vasculature

The erectile tissue of the penis is composed of two functional compartments - the corpora cavernosa and the corpus spongiosum. The corpora cavernosa consists of two cylinders with a common septum that is perforated by vessels that allow free passage of blood from one to the other and thus allows the two bodies to function in part as a single unit (3) (Figs. 1 and 2). The corpus spongiosum contains

the urethra and enlarges distally to form the bulk of the glans penis. The erectile tissues are surrounded by a dense fascial sheath, termed Buck's fascia, which anteriorally anchors the penis to the symphysis pubis (4).

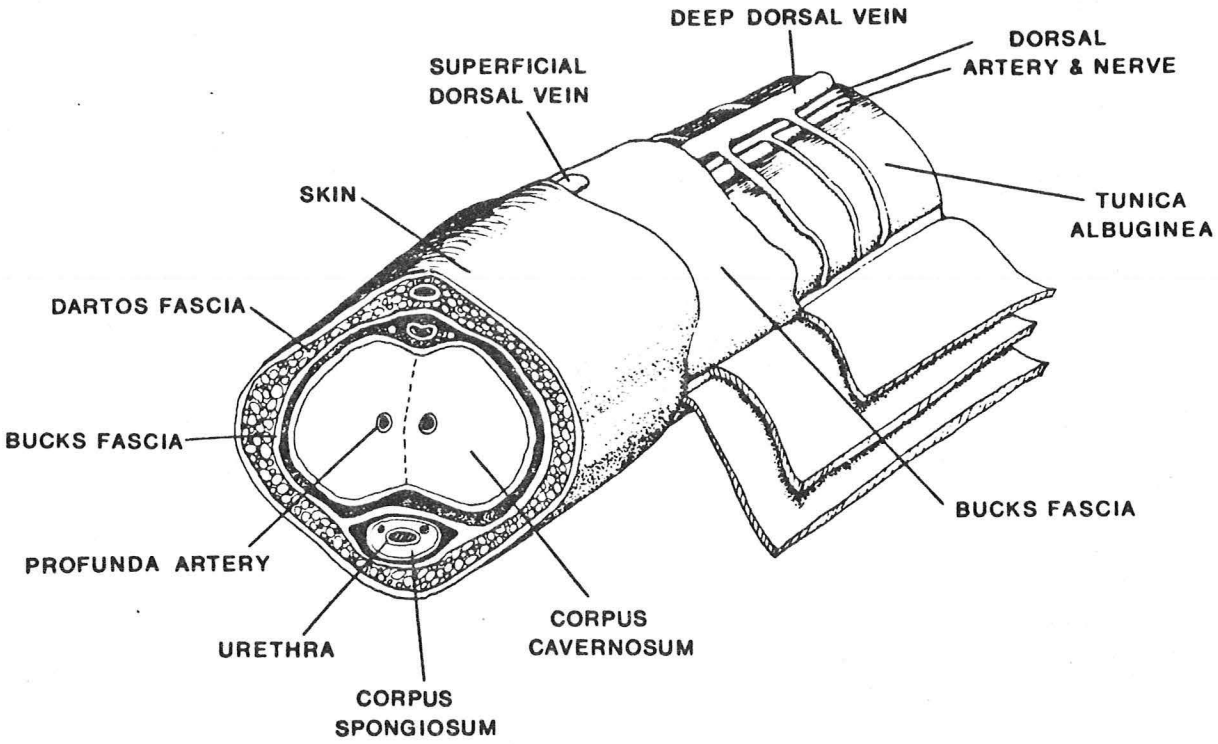

Fig 1.—Anatomy of the penis. Included is a cross-sectional and unfolded longitudinal view of the pendulous portion of the penis.

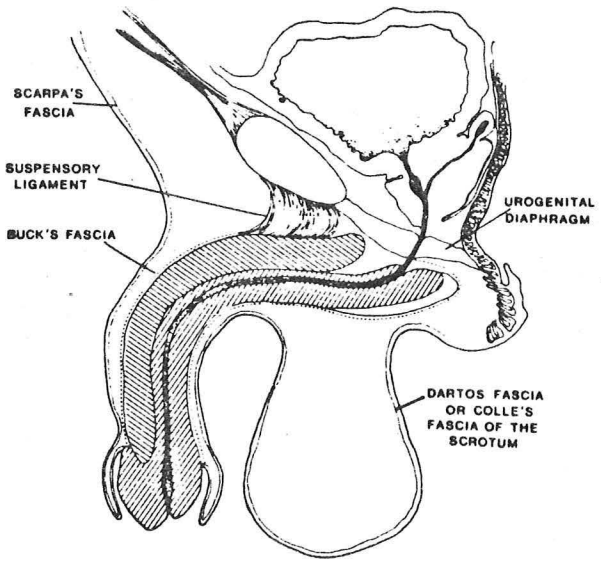

Fig 2.—Fascial relationships of the external genitalia.

The arteries of the penis are derived from the internal pudendal arteries and divide into three sections -- the dorsal artery of the penis, the profunda branch that supplies the corpora cavernosum, and the branch that supplies the urethra and spongiosum. Anastomoses connect all three pairs of arteries along the entire course. The venous drainage consists of three major divisions -- superficial, intermediate, and deep -- as well as anastomotic communicating vessels that allow the system to act as one functional bed. The more superficial veins drain into the saphenous, femoral, and scrotal system whereas the remainder drain into the deep veins. In the flaccid state, most blood is shunted away from the erectile tissue, possibly by direct anteriovenous anastomoses (5).

Three types of nerve fibers innervate the penis -- sympathetic, parasympathetic, and somatic. The somatic innervation is derived from S_2-S_4 and involves almost all components of the penis, particularly the sensory innervation of the skin. The sympathetic component is derived from spinal cord segments T_{11} and T_{12}. The parasympathetic fibers arise from ventral root segments S_2 and S_4. These two types of autonomic fibers intermingle and give rise to the prostatic plexus and distally to the cavernous plexus of nerves. Direct electrical stimulation of the plexus along the posterior surface of the prostate results in erection. The predominant type of nerve ending in the penis itself is adrenergic, and norepinephrine is present in the corpora cavernosa in large amounts (6).

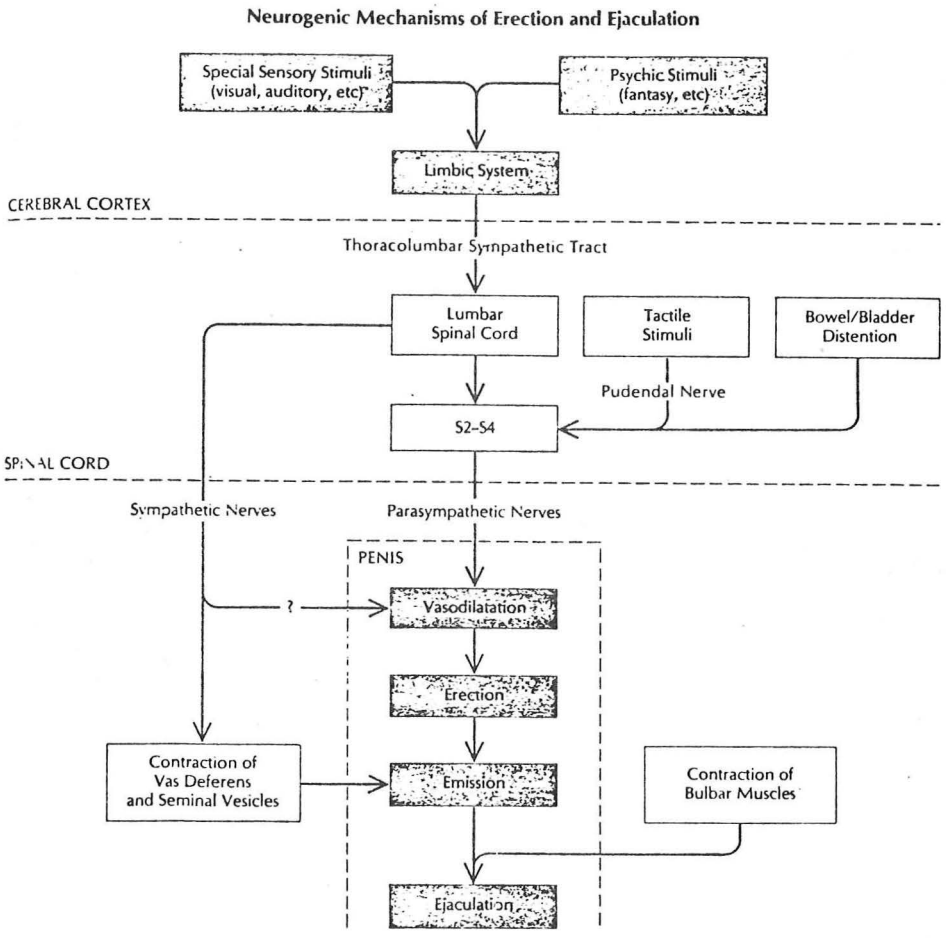

Figure 3

Erection

Penile erection is the consequence of engorgement with blood that results in rigidity of the penis. During its development the volume of blood entering the penis must exceed the volume leaving it, and when full erection is achieved a new steady state ensues in which inflow equals outflow. Detumescence in turn requires that outflow temporarily exceed inflow. Whether penile erection is the result of diminished outflow or increased arterial inflow or both was long disputed, but the bulk of evidence favors increased inflow because of decreased resistance within the vascular bed as the major event (7). Neurologically-mediated venous control mechanisms may also play a role. (The long-held view that venous valves or polsters play the central role in controlling the exit of blood from the penis has been refuted by careful anatomic studies.)

The flaccid penis contains about 8 ml of blood, and the erect penis contains about 62 ml. Intrapenile blood flow increase on average about 25 fold from an average of 2 ml/100 g/min in the flaccid state to rates as high as 50 ml/100 g/min during erection (9-11). This change is unaccompanied by alterations in cardiac output or in blood flow to the pubic area. Increased blood flow by itself could not change the volume of the penis, and most theories of erection assume that blood is shunted away from the erectile tissue in the flaccid state and that AV shunts are closed during erection, thus diverting blood into the cavernous spaces. When the human penis is perfused with saline, moderate swelling occurs at rates less than 20 ml/minute, and full erection occurs at rates of perfusion between 20 and 50 ml/min; once erection is achieved it can be maintained by lower perfusion rates of around 12 ml per minute (12). The maximal flow rates decline with age, presumably because of arteriolar narrowing (13).

Two types of stimuli can elicit an erection (Fig. 3). Psychogenic stimuli include auditory, visual, olfactory, gustatory, tactile, and imaginative influences. Reflexogenic stimuli include those derived from genital manipulation. These various inputs work via parasympathetic and sympathetic mechanisms. Reflexogenic erection in men is believed to be mediated by parasympathetic efferents. The neural effectors of psychogenic erections may be predominately sympathetic (7). The final neurotransmitter(s) for these systems are not known with certainty, but α-adrenergic receptors are more abundant than β-receptors (14, 15). α-adrenergic blockers can produce erections, and it is possible that chronic α-adrenergic-mediated arterial constriction must be released before erection occurs. Cholinergic nerve endings are also present in the penis (16, 17).

Vasoactive intestinal polypeptide (VIP) may also play a major role as an effector of erection. VIP nerve fibers are present in the male urogenital tract and are particularly rich in the smooth muscle of the penis; this mediator may act like α-adrenergic receptors tonically to inhibit smooth muscle contraction in the tissue (18-20). Other candidates for roles as inhibitory mediators have been proposed (21).

Emission, Ejaculation, and Orgasm

The emission of the semen into the posterior urethra is the result of contractions of the ampulla of the vas deferens, the seminal vesicles and the prostatic smooth muscles. The process is a cord reflex and like erection is under considerable cerebral control (7). Ejaculation -- the expulsion of the semen from the urethra -- results from the squeezing action of the bulbocavernosus muscles at 0.8 second intervals accompanied by simultaneous contraction of the muscles of the

pelvic floor and of the distal sphincter of the bladder (22). Ejaculation is normally a reflex reaction to the collection of semen in the bulbous urethra (23). If the sphincters fail, semen may regurgitate into the bladder. Orgasm, the pleasurable sensation that accompanies ejaculation, is even less well defined. Whether the perception of the contractions of the pelvic musculature during ejaculation is the sine quo non of orgasm is unsettled, but under rare circumstances orgasm can clearly be generated cerebrally without input from the genitalia, as for example in patients with temporal lobe lesions (22).

Hormonal Control

Male hormones are responsible for development of the male genitalia and for maturation of male erectile physiology and sexual behavior at the time of puberty. The role of androgens in the maintenance of male sexual behavior, once established, is less clear. In male animals, orchidectomy is followed by retention of mating capacity for a variable period of time and then by eventual failure (24). In the human male prepubertal castration appears to prevent uniformly the development of normal male behavior, and orchiectomy in the adult has sequelae similar to that in animals, i.e. castration of adult men causes a decline in sexual activity with only occasional castrated men continuing to have intercourse over a period of years (25, 26). Furthermore, physiological androgen replacement in such men causes a rapid and reliable restoration of male sexual activity (27-31). In men with low testosterone values (but above the castrate range) androgen replacement appears to enhance the frequency of spontaneous erections rather than the capacity to initiate and complete intercourse, suggesting the possibility that its major effect is at the cerebral level (31). At any rate, there is considerable similarity between the hormonal control of male sexual behavior in man and in animals.

The identity of the hormones that regulate male sexual behavior is not so clear. Occasionally castrate males of all species sustain the capacity and the drive for intercourse over long periods (25, 26). In the castrate male considerable estrogen and small amounts of testosterone are formed in extraglandular tissues from adrenal androgen (32), and in some animal species estradiol enhances the effect of androgen on male sexual drive (33). Thus, the small amounts of testosterone and/or estrogen formed by this mechanism may be enough to sustain libido and potentia in some adult male castrates. Presumably, those men who have the greatest capacity to form these agents in peripheral tissues would be most likely to sustain sexual activity following castration.

FEMALE SEXUAL RESPONSE

The clitoris is the female counterpart of the glans penis, and its erectile component is analogous to the corporus spongiosum. The labia minora are homologues of the shaft of the penis, and their erectile elements thus correspond to the corpora cavernosum. The labia majora (like the male counterpart the scrotum) does not contain erectile elements. The vagina is lined by a mucosal surface that is the source of the vaginal lubrication. It is presumed that the innervation of these components, like in the male, involves both sympathetic and parasympathetic components and that sexual arousal (and erection) involves increased blood flow to the vagina, the clitoris, and the labia minora (34). Indeed, vaginal blood increases from an average value of 9.8 ml/min/100 g to an average of 28.9 ml/min/100 g during sexual stimulation (35).

As in men, sexual arousal in women involves varying combinations of psychic and reflex stimuli and is manifested by expansion of the inner two-thirds of the

vagina. The clitoris increases in size, the labia minora become engorged, and the outer third of the vagina becomes engorged. As a result the opening of the vagina narrows. Thus, at physiological and functional levels, sexual arousal in women is similar to erection in men. There is no female counterpart of ejaculation, although vaginal lubrication is an essential feature of sexual arousal.

Orgasm in the female is marked by the simultaneous rhythmic contractions of the uterus, the outer third of the vagina, and the rectal sphincter, beginning at 0.8 second intervals and then diminishing in intensity, duration, and regularity (34). As in the male, orgasm is the perception of a pleasurable sensation associated with these rhythmic contractions.

Endocrine Control of Female Sexual Behavior

In animals, oophorectomy causes a dramatic cessation of female sexual activity whereas in women the ablation of ovarian secretion by oophorectomy or via a natural menopause has no consistent effect on sexual activity (24). The standard interpretation is that once sexual patterns are fixed in women, sexual drive is endocrine independent. Indeed, it is not established whether hormones are involved in the genesis of normal sexual drive at female puberty. This interpretation may not be correct since removal of the human ovaries does not ablate the production of testosterone or of estrogen. Indeed in women 30-50% of total estrogen production is derived ultimately from adrenal androgen, and about half of testosterone production is directly secreted by the adrenal (24, 32). The net effect is that castration in women cuts the production of androgen and estrogen to half or less and does not have a dramatic effect on the ratios of the two steroids. However, when castrated women are subjected to adrenalectomy (36) or to hypophysectomy (37), there is a profound decrease in sexual desire. Thus, it is possible that the sexual life of women is as hormone dependent as that of female animals. Adrenal androgen (ablated by hypophysectomy or adrenalectomy) could have a direct effect on sexual desire in women, or adrenal androgen could act as a prohormone for estrogen synthesis in peripheral tissues and supply sufficient estrogen for maintenance of sexual drive in the absence of the ovaries. It is clear, however, that variations in levels of the sex steroids over a broad range has at best only minor effects on the sex drive of women (38-45).

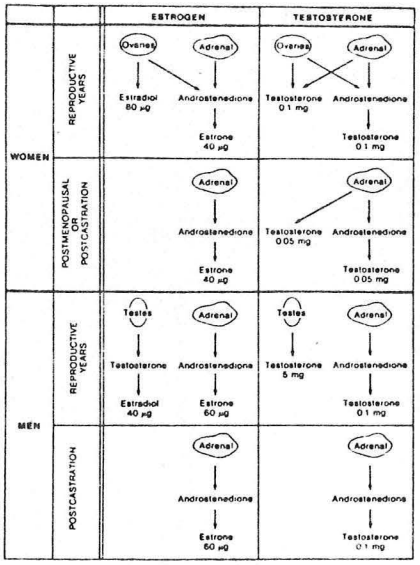

Fig. 4 Contribution of the gonads and the adrenals to the major circulating androgens and estrogens in the human during the reproductive years and in the castrate or postmenopausal state. The data are meant to be representative only.

THE EVALUATION OF SEXUAL DYSFUNCTION

The aim of evaluation is to separate psychogenic from organic causes and to identify the nature of the organic cause when present. The techniques include the traditional medical and psychosocial history, physical examination, baseline laboratory evaluation, and selected specialized techniques. In women, specialized techniques such as vaginal photoplethysmography are largely research tools and have not been applied successfully for clinical use (46). In men, however, several procedures have proved useful in the assessment of erectile function (47, 48).

The most widely used of these techniques is the assessment of nocturnal penile tumescence (NPT). Throughout adult life erections occur during the rapid eye movement phase of sleep, and the total time of NPT averages 100 minutes per night (49) (Fig. 5). Whether one has an erection upon awakening in the morning

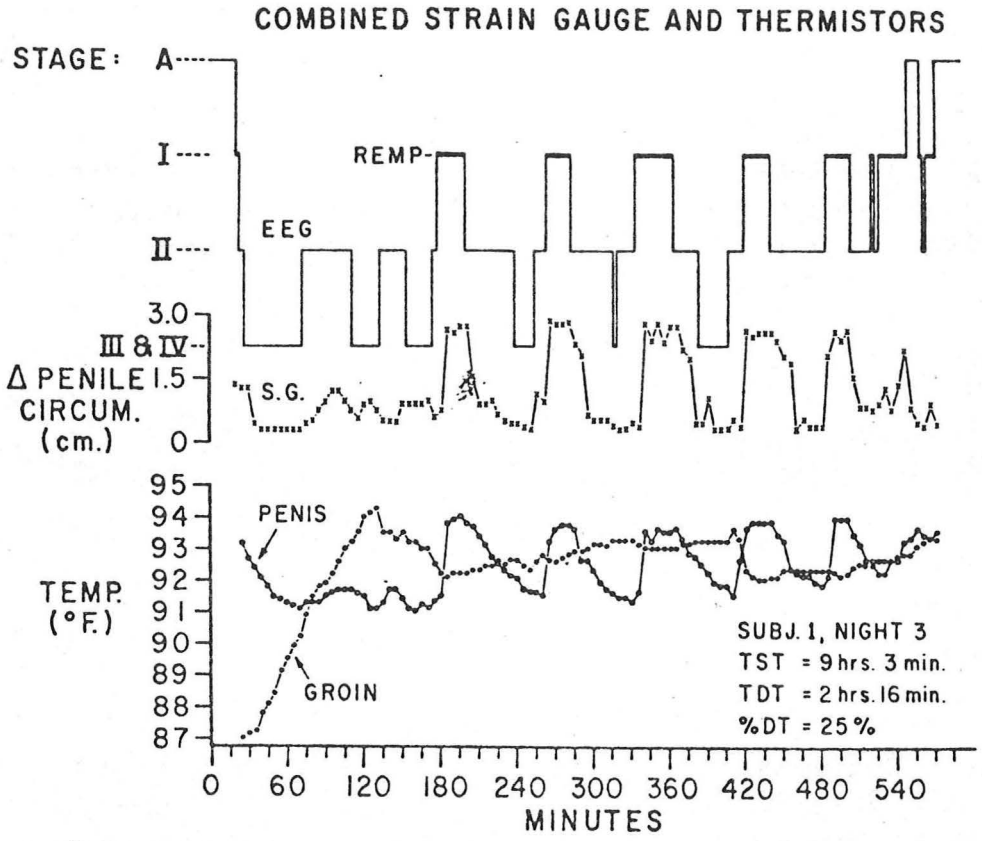

Fig 5—Combined strain gauge and thermistor. The upper graph shows the stages of the EEG plotted against time; the REMPs are indicated by the darker horizontal lines. Directly below is a graphic representation of the increases in penile circumference in centimeters as measured by the strain gauge (*SG*). For the first four REMPs, the increases are of an order of 2.5 cm or more indicating full erection. These increases are sustained practically throughout the duration of the REMPs with very little fluctuation. The lower graph is a representation of the penis and groin temperatures throughout the course of the night. Penis temperature gradually fell about 2° during the early part of the night and then stabilized, but with each REMP and synchronous with the increase in circumference there were rises of penile skin temperature of an order of 2.5° to 3°. During detumescence, temperature decreases at a slower rate than the circumference changes because of the time necessary for the dissipation of the heat. The groin temperature increased sharply from 87-94° in the early part of the night and thereafter remained at a relatively even level for the rest of the night. There was a slight tendency towards a fall in groin temperature of an order of 0.5° during each REMP; there is an inverse relationship between penis and groin temperatures.

depends upon the phase of sleep when awakening occurs. Consequently, a history of turgid erections upon awakening strongly suggests that the psychic, efferent, neurologic, and circulatory systems that mediate erection are intact and that erectile dysfunction is probably due to a psychogenic cause. The history of absence of nocturnal or awakening erections is, however, impossible to interpret, and several objective procedures for monitoring NPT have been devised for use at home or in the hospital setting. All involve the attachment of a strain gauge to the penis as a means of quantifying erections. As this procedure has been utilized more widely, it is now clear that it is of usefulness. While the length of "erect" time per night declines only slightly with age from the 20's to the 70's (50) many of these erections are without sufficient rigidity to allow vaginal penetration (51-53). The latter occurs because a maximal change in penile circumference occurs at an intracavernous pressure below the pressure required for full erection (54). Furthermore, occasional patients with sensory neuropathy may continue to have nocturnal erections. Recognizing these limitations, the technique appears to provide a valid means of identifying psychogenic impotence most of the time (55, 56). Those patients whose expansion or rigidity characteristics are not within the range of normal should undergo further assessment for vascular and neurologic disease. The quality or rigidity of the erection can be estimated by transducer methods (53), and penile blood flow or pressure can be measured by Doppler techniques, although they rarely record the flow to the corpora cavernosa (58). The measurement of bulbocavernosus reflex latency is one means of assessing neurogenic causes of erectile dysfunction (47).

SEXUAL DYSFUNCTION IN MEN

Male sexual dysfunction, often termed impotence, can be manifested in several ways: loss of desire, inability to obtain or maintain an erection, premature ejaculation, absence of emission, inability to achieve an orgasm, or failure of detumescence. Some experience more than one abnormality simultaneously. Such complaints can be the secondary consequence of debilitating diseases, the consequence of specific disorders of the urogenital or endocrine systems, or the result of psychological problems. In all instances it is essential to separate psychological from organic causes because the treatment modalities are so different.

Loss of Libido

Androgens have a major influence on sexual desire in men, and a decrease in libido may result from either pituitary or testicular deficiency. This possibility can be assessed by measurement of plasma testosterone and plasma gonadotropins. However, since the level of testosterone required to sustain libido is usually less than that necessary for stimulation of the prostate and seminal vesicles (and hence for formation of the ejaculate) decrease or absence of the ejaculate is a feature of loss of libido associated with hypogonadism. Conversely, if the semen volume is normal, it is unlikely that endocrine factors are responsible for sexual dysfunction. Some drugs also cause loss of sexual desire, and in many instances loss of desire is sometimes difficult to separate from erectile failure. Likewise, causes of erectile failure and ejaculatory failure also tend to overlap.

Erectile Failure

The organic causes of erectile failure can be divided into specific subgroups (2, 47, 48) (Table I). In many instances a likely diagnosis can be reached by history

and physical exam alone. However, in the evaluation of patients it is important to keep several problems in mind. One, there is an enormous variability in the sex drive or libido of normal individuals, and no recognized cause of impotence - whether it is castration, radical prostatectomy, or transection of the cord - causes

Table I. Some Organic Causes of Impotence

- Endocrine
  - Testicular failure (primary or secondary)
  - Hyperprolactinemia
- Penile Diseases
  - Previous priapism
  - Phimosis
  - Peyronie's disease
  - Penile trauma
- Vascular
  - Large vessel atherosclerosis
  - Arteritis
- Neurologic
  - Temporal lobe lesions
  - Disease of the spinal cord
  - Loss of sensory input (peripheral neuropathies such as diabetic neuropathy; tabes dorsalis; disease of the dorsal root ganglion)
  - Post operative disturbances of the nervi erigentes
    - Perineal prostatectomy
    - Vascular surgery
    - Sympathectomy
    - Abdominoperineal resection
- Systemic Diseases Causing Impotence
  - Cirrhosis of the liver
  - Renal failure
  - Chronic debilitating diseases
  - Congestive heart failure
  - Angina pectoris
- Drugs
  - Antihypertensive Drugs
    - guanethidine
    - reserpine
    - phenoxybenzamine
    - clonidine
    - methyldopa
    - thiazides
    - spironolactone
    - chlorthalidone
  - Anticholinergic Drugs
    - trihexyphenidyl
    - benztropine
    - atropine
    - scopolamine
  - Antihistamines
    - diphenhydramine
    - hydroxyzine
    - cimetidine
  - Antipsychotic Drugs
    - phenothiazine
    - thioxanthenes
    - butyropherone
    - thioridazine
  - Antidepressant Drugs
    - tricyclic antidepressants
    - monoamine oxidase inhibitors
  - Sedatives and Drugs of Abuse
    - alcohol
    - barbiturates
    - diazepam
    - chlordiazepoxide
    - cannabis
    - methadone and heroin
  - Others
    - fenfluramine
    - levodopa
    - aminocaproic acid
    - clofibrate
    - baclofen
    - ethianomide
    - perhexiline

impotence in all people. The reason for this variability in response has never been studied systematically in physiological terms except that it is clearly not due to differences in plasma testosterone levels. It is likely that the fraction of men with the highest sex drive have a better chance of preservation of erectile capacity, regardless of the supervening organic disorder. Two, in regard to drugs, it is difficult in many instances to ascertain whether a specific side effect such as impotence is the consequence of the drug alone, the effects of the background disease, or the combined effect of a given drug and a disease such as a beta blocking agent in a man with mild atherosclerosis and partial decrease in penile blood flow. Certainly, not all patients who take these drugs develop impotence. This same phenomenon also occurs in other forms of impotence in which more than one cause may interact to produce impotence. For example, neuropathy and vascular insufficiency may both be involved in the impotence of diabetes mellitus, and it is possible that the neurogenic trauma of pelvic surgery is most apparent in men with underlying compromised vasculature. Drug causes can be identified with certainty only if the symptoms disappear when the drug is discontinued (not always possible in the severely ill). Three, identification and correction of an organic cause does not always restore potency. The effects of sexual failure can be so devastating to the ego as to lead to psychological impotence, and the appropriate management of such problems may involve both correction of the organic disorder and major psychological support.

Differential Diagnosis

Endocrine. Testicular failure is beyond the scope of this discussion. Nevertheless, several specific points need to be kept in mind in regard to impotence. The first is that testicular failure is a common side effect of cancer chemotherapy; such agents usually have primary toxicity on the spermatogenic tubules, but diminished testosterone secretion is also common. In such instances androgen therapy may be effective in restoring sexual drive. The second is that some drugs may cause impotence by endocrine mechanisms. Spironolactone and cimetidine act as antiandrogens by competing with androgens for binding to the androgen receptor (59).

Hyperprolactinemia constitutes a special problem in impotence (60). There is little doubt that severe hyperprolactinemia is associated with impotence, but the mechanism by which this occurs is complex. In some instances, this is due to the effects of large prolactin-secreting pituitary tumors in causing compression of the remainder of the pituitary and hence in causing a secondary hypogonadism in which testosterone deficiency is the proximate cause of impotence. In other instances, however, microadenomas of the pituitary cause hyperprolactinemia without producing any overt adverse effect on plasma gonadotropins or plasma testosterone. In some (but not all) such instances impotence appears to be due to prolactin itself and can be cured by lowering serum prolactin to normal (60). It is uncertain whether in such instances hyperprolactinemia acts peripherally or centrally to inhibit sex drive. It is possible that some drugs such as phenothiazines cause impotence by enhancing prolactin levels. It should be kept in mind that hyperprolactinemia is an unusual, even rare cause of impotence in most clinics (61), but because the condition is treatable, prolactin should probably be measured as a routine part of the workup of impotence (60).

Penile Diseases. Penile diseases are usually encountered by urologists. Priapism can result in fibrosis of the vascular sinusoids and thus lead to erectile incapacity (48). Peyronie's disease is a chronic inflammatory disorder of unknown

etiology that causes a fibrosed scar in the tunica albuginea. Impotence can result either from the pain associated with erection or because of the obstructive effect of the lesion on the peripheral normal tissue (48). Phimosis is treatable with circumcision, whereas early surgical repair may be unsuccessful in traumatic rupture of the urethra (48).

Vascular. Vascular disturbances are probably the most obvious cause of impotence from an etiologic standpoint. They are fundamentally of two types. First, atherosclerosis of large vessels or of the common iliac, hypogastric, or pudendal artery can lead to inadequate perfusion of many tissues including the penis (62). This may be manifested by inability to obtain or to maintain an erection. The latter in turn may be due to a "steal phenomenon" in which detumescence occurs as soon as active pelvic movements begin. It appears that blood is drawn away from the penis to large muscle groups in the legs and hips during sexual activity (63). Recognizing its limitations, the best means of quantifying vascular insufficiency is the measurement of penile blood flow (58). Second, obliteration of the small vessels of the carvernous tissue is a common feature of aging (8, 13). The earliest manifestation of this process is hyperplasia of intimal smooth muscle at the branch points of the arteries. These structures were originally believed to be physiological regulators of blood flow (polsters) but are now believed to be manifestations of local atherosclerosis (8). Similar changes occur approximately 15 years earlier in diabetics (13). The progressive nature of these lesions probably causes the gradual diminution of erectile capacity (and more commonly) of erectile rigidity with age. Thus, the presence of adequate femoral, dorsalis pedis, and posterior tibial pulses does not preclude impediment to corpora cavernosa blood flow.

Neurologic. Neurologic disorders of the central and peripheral nervous system are often accompanied by erectile dysfunction (64, 65). In certain of these disorders such as cerebral vascular accidents, it is unclear whether the effects are specific or nonspecific (65). The same is true of temporal lobe epilepsy, Parkinson's disease, Shy-Drager syndrome, encephalopathies, Alzheimer's disease, etc. (48). Two types of neurological lesions are of particular interest -- spinal cord disease and peripheral neuropathy. Spinal cord injuries have been studied in detail (66). Erection is usually unimpaired in men with incomplete upper motor neuron lesions; the erections are usually reflexogenic but may also occur on a psychogenic basis in half (66). In complete upper motor neuron lesions reflexogenic erections occur in 90-100%. In men with lower motor neuron lesions reflexogenic reflexes are absent, but psychogenic erections occur in most incomplete lesions and in about a fourth of such subjects with complete lesions (66). Ejaculation is more impaired in upper than in lower motor neuron lesions, and fertility is present in 10 percent or less of these patients overall.

Diabetes mellitus is one of the most common causes of erectile failure. About 15 percent of diabetic men below the age of 35 and 55 percent of diabetic men by age 60 are impotent. Libido is almost always preserved, and androgen levels are uniformly normal (67). Diabetic neuropathy has long been considered to be the major etiologic factor in this impotence. Somatic and autonomic nervous system neuropathies are more common in impotent than in potent diabetics (68), and defects of the sacral reflex arc have been demonstrated by several techniques (69). Furthermore, the norepinephrine content of the corpora cavernosa is decreased in diabetic patients with erectile impotence as compared with levels in men with impotence due to non-neurological causes (70). Nevertheless, there is now considerable uncertainty about impotence in the diabetic, and evidence has

accrued to suggest that the disorder is predominately vascular in nature. Not only as described above are arteriolar lesions prominent in the corpora cavernosa of diabetics, but Jevitch et al have shown that 95% of impotent diabetic men have diminished blood flow whereas only 34% have demonstrable neuropathy (69). In another study 9 of 13 impotent diabetics had diminished penile blood flow (71); vascular lesions in impotent diabetics are similar in scope and magnitude to those in impotent men without diabetes (72). Furthermore, virtually all impotent diabetics have normal antegrade ejaculation. Thus, erectile failure in this condition is probably due predominately to vascular factors.

Impotence is common after a variety of urological, abdominal, and pelvic operations including open prostatectomy (particularly radical prostatectomy for prostatic cancer), external sphincterectomy in subjects with paralysis of the bladder, radical cystectomy, retroperitoneal lymphadectomy, and sympathectomy and after extensive radiation to the pelvis (48). In contrast, impotence is unusual after transurethral resection (73, 74). Walsh and Donker have recently reported that the nerve supply to the penis (the nervi erigentes) runs through the lateral pedicle of the prostate (75, 76) and that if the nerves are preserved when radical prostate surgery is performed, potency can be preserved in most men. Lue et al have reported that these nerves are also adjacent to the rectum and are easily damaged during a variety of urological and pelvic procedures (77). Thus, it appears that iatrogenic impotence that follows surgical procedures is fundamentally neurogenic in origin and is preventable in large part (Fig. 6).

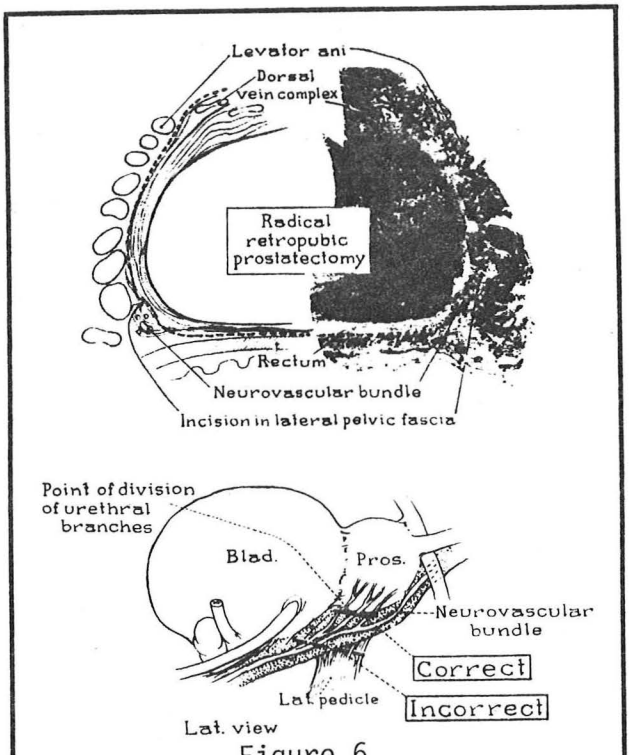

Figure 6

***Top:** Schematic diagram of surgical plane employed in Walsh's modified radical retropubic prostatectomy indicating site for incision in lateral pelvic fascia which avoids injury to neurovascular bundle. **Bottom:** Schematic diagram of correct site for ligation of lateral pedicle. (Reprinted with permission from* Prostate, *October 1983.)*

Systemic Diseases. It is hardly surprising that a variety of systemic diseases are associated with erectile impotence and that it is difficult to separate the effects of debilitation and psychological factors associated with the illnesses from specific organic effects. In some instances (cirrhosis of the liver and chronic renal failure) impotence occurs against a background of diminished plasma testosterone and elevated plasma estradiol, and endocrine factors may play a role (50). In other instances (men on chronic hemodialysis) neuropathy may be etiologic in impotence (78). In congestive heart failure cardiac output may not be adequate, and the psychic stress associated with severe angina may lead to erectile impotence. In most instances, however, it is likely debility itself which is causal.

Drugs. A wide variety of drugs are associated with impairment of sexual function in men (47, 48, 79-81) (Table I). In some instances the effects of the drugs are predictable on the basis of the known pharmacology. In view of the established role of the central nervous system centers of arousal and of the sympathetic and parasympathetic nervous systems in sexual function it is logical that sedatives, anticholinergics, and blocking drugs can cause erectile and/or ejaculatory failure. Furthermore, it might be expected that antiandrogens (spironolactone and cimetidine) and drugs that raise plasma prolactin levels (phenothiazines) act to inhibit erectile capacity by these mechanisms. Nevertheless, in the case of many drugs, there is no ready explanation for the effect (aminocaproic acid, thiazide diuretics, ethianomide, etc.). Furthermore, α-blocking agents have paradoxical effects; injected into the corpora cavernosum they may cause erection (82), whereas systemically they impair ejaculation. As stated above, none of these agents causes impotence in all subjects, and it is a common experience for patients to report impotence on a given drug such as guanethidine and then experience no improvement when the drug is discontinued. In such instances the general debilitating effects of the illness for which the drug is prescribed or specific local factors such as vascular insufficiency may interact with the drug in question. It is safe to ascribe impotence to a given drug only if potency is restored upon discontinuation of the drug.

With these reservations in mind, alcohol deserves special comment. Independent of cirrhosis of the liver, impotence is exceedingly common in alcoholic men (83). In part, this may be the consequence of a secondary hypogonadism that appears to result both from a direct toxic effect at the level of the testes and an inhibition of the hypothalamic-pituitary system (83). However, it is likely that the impotency cannot be ascribed to endocrine effects but is instead a result of other consequences -- nutritional and toxic -- of alcoholism. In a long-term followup of impotent chronic alcoholics, abstinence resulted in recovery of potency in only a fourth of 60 men (83). The longer the duration of alcoholism, the less the chance of recovery upon abstinence.

Therapy

In most clinics, organic causes are believed to contribute to impotence in about half of patients (84, 85). Therapy in some of these cases is obvious and successful. Effective androgen replacement in hypogonadal men, lowering of plasma prolactin levels to normal in men with prolactinomas, substitution of one antihypertensive drug for another, abstinence from alcohol or cannabis, treatment of a coexisting systemic disease, surgical repair of phimosis or Peyronie's disease can all effect dramatic cures. Furthermore, patients whose atherosclerosis is limited to large vessel disease may experience dramatic improvement following surgical repair. It is also clear that androgen therapy has no role to play in the

absence of true hypogonadism; in carefully controlled studies, androgen supplementation is no different than placebo in improving potency (86), and despite initial claims to the contrary LHRH therapy is not of benefit in impotence (86).

Two radical experimental treatments have been proposed for impotence -- namely injection of phenoxybenzamine (82) or vasoactive intestinal polypeptide (87) directly into the corpora cavernosa of impotent men. In all likelihood the importance of such therapies is in the information they may shed on the normal process rather than as a treatment modality.

The remaining patients who have neurogenic and vascular etiologies -- the majority of patients with organic impotence in most series -- are candidates for prosthetic surgery. Surgical management is now an effective and established means of treating erectile dysfunction (49, 88-90). Two types of prostheses are available (Table II): paired relatively rigid, fixed silicone rods that are implanted in the corpora cavernosa and that import a state of constant semi-erection to the

TABLE II (Ref. 49)

Comparison of the Rigid and the Inflatable Penile Prostheses

	Rigid	Inflatable
Cost (approximate)	$260	$1,675 (1981)
Size	12 cm–22 cm lengths, diameters 0.9, 1.1, 1.3 cm; selection of correct size critical in order to avoid SST deformity	Cylinders available in several sizes although sizing less critical with this device
Complexity of implantation	Relatively simple, device rapidly inserted	Technically more difficult; requires longer operating time (30 min. to > 1 hour)
Cosmetic results	Permanent semierection with potential for embarrassment and/or discomfort	Erect and flaccid penis normal in appearance; prosthesis not detectable by partner
Postoperative complications	Infection, perforation of glans due to incorrect sizing, pressure necrosis of urethra, occasional SST deformity	Infection (similar incidence to that seen with semi-rigid devices); mechanical failure, paraphimosis, scrotal erosion/hematoma, buckling of glans due to improper placement of cylinders
Functional results	Not absolutely correlated with technical operative result	Direct correlation between functional and operative results
Patient-partner satisfaction	85–95%	85–95%
Recommendations for selection of specific prosthesis	Peyronie's disease, quadriplegics with impaired manual dexterity, paraplegics with condom catheter drainage	Younger, physically active patients, those requiring intermittent transurethral procedures, or those with diminished penile sensation (to decrease risk of pressure necrosis)

penis and the inflatable prosthesis, a hydraulically controlled device that allows simulation of the natural processes of tumescence and detumescence. Both types of prostheses are designed to provide sufficient rigidity to the penis to allow intromission and pelvic thrusting during coitus. When the surgery is performed by skilled surgeons both types of prostheses are associated with comparable complication rates and functional performance. Success rates, measured in terms of patient and partner satisfaction, are generally quite high.

Ejaculatory Dysfunction

Premature ejaculation is rarely organic in nature. It is usually the result of anxiety about sexual performance or of some other emotional state. The management of premature ejaculation has been reviewed by Levine (91).

Failure of emission can result from retrograde ejaculation, sympathetic denervation, drugs, or androgen deficiency. The latter is almost invariably associated with impotence, and pharmacologic causes, particularly guanethidine, phenoxybenzamine, and phentolamine, can be identified with an appropriate history. Retrograde ejaculation may occur following surgery on the bladder neck or may occur spontaneously in the course of development of autonomic nervous system neuropathy. The diagnosis is established by the demonstration of sperm in a postcoital urine specimen. Sympathectomy or other surgery that impairs the autonomic innervation of the prostate, seminal vesicles, ejaculatory ducts, and pelvic musculature may cause absence of smooth muscle contraction at the time of emission and ejaculation.

If libido, erectile function, and ejaculation are intact the absence of orgasm in men is almost invariably a psychological problem.

Priapism

Priapism, failure of detumescence, is persistent painful erection that is rarely related to sexual activity. The etiology is thought to be clotting within the penile vascular framework, and it can either be idiopathic or secondary to sickle cell anemia or chronic granulocytic anemia. The sequelae of persistent erection is fibrosis of the vascular network and subsequent erectile impotence (48).

SEXUAL DYSFUNCTION IN WOMEN

Sexual dysfunction has not been studied as systematically in women as in men. This is in part because of technical limitations and in part because the female equivalents of erection and ejaculation have less clearcut end points and are more difficult to define in quantitative terms. Most women who consult physicians because of sexual disturbances do so because of failure of arousal, orgasmic failure, dyspareunia, or vaginismus.

Failure of Arousal

The normal sexual response begins with arousal which causes vasocongestion of the vagina, labia minora, and clitoris and results in vaginal lubrication in preparation for intromission. This lubrication is due to the formation of a transudate in the vagina and in conjunction with the genital congestion produces the so-called orgasmic platform prior to orgasm. Healthy vaginal tissue and appropriate sexual stimuli -- visual, tactile, auditory, olfactory -- are prerequisites for genital vasocongestion and vaginal transudation.

Estrogen deprivation associated with menopause - surgical or natural - inevitably causes vaginal atrophy and decreased vaginal lubrication. Effective hormone replacement in such women enhances vaginal lubrication and sexual enjoyment (92). Illness that impair neurological function such as diabetes mellitus or that impair the circulation such as atherosclerosis may also impair normal sexual arousal similar to their effects on erectile function in men. Likewise, drugs that

impair male sexual function in men and systemic disorders such as cardiovascular disease may have similar adverse effects on sexual arousal in women. Indeed, it is likely that all causes of erectile failure in men (Table I) can also inhibit the sexual arousal of women. Nevertheless, it is generally believed that failure of arousal is most commonly due to psychological causes (34).

Orgasmic Failure

Orgasm requires intact autonomic nerve supply to the pelvic musculature. Failure to achieve orgasm in women is a common form of sexual dysfunction and may be either primary or situational. Those factors that lead to failure of sexual arousal in women also can cause failure of orgasm, as can gynecological factors. In the Masters and Johnson experience, however, 95 percent are believed to be psychogenic in origin (34).

Vaginismus

Vaginismus, painful, involuntary contractions of the musculature surrounding the entrance to the vagina, is a rare cause of dyspareunia. It may affect women of any age and varies in severity. It is a conditioned response to a previous organic or psychogenic trauma. Among organic causes are hymeneal abnormalities, genital herpes, obstetric trauma, and atrophic vaginitis. More commonly, however, no organic cause can be implicated (34). In such cases a variety of psychosocial factors may be implicated including negative conditioning to sex during childhood, traumatic sexual experiences, or phobias about pelvic examinations, pregnancy, or venereal disease. When the spasm is incomplete or moderate coitus may be possible although painful, and patients may actually present as dyspareunia. Treatment is directed to elimination of the conditioned response by progressive vaginal dilation by the patient in conjunction with psychotherapy.

Dyspareunia

Pain upon intercourse can be due to vaginismus (above), to vaginal atrophy and diminished vaignal lubrication, or to organic causes. Uterine pain is often chronic and continuous and may be increased during intercourse. Causes include leiomyomas of the uterus (particularly submucous and degenerating leiomyomas, infections of the uterus, and, rarely, endometrial or cervical cancer. The most common cause of adnexal pain is infection which may be either chronic or acute. In addition, ovarian neoplasms, ectopic pregnancy, and endometriosis may cause adnexal pain. Vulvar or vaginal pain is usually infectious in origin; vaginitis may be due to a variety of organisms. Vulvar pain may arise from herpes, condyloma acuminata, or from cysts or abscesses of Bartholin's glands. These disorders are fundamentally gynecological in origin except for vaginismus.

APPROACH TO THE PATIENT WITH SEXUAL DYSFUNCTION

The means of determining whether sexual dysfunction is organic or psychogenic are imprecise. It is often difficult to determine whether a recognized organic problem is truly etiologic or merely coincidental. On the one hand, dysfunction that is psychogenic in origin may be labeled organic because of the presence of a medical condition that is known to be associated with impotence. Likewise, a patient may appear to be psychogenically impotent or frigid because of changes in affect and mood that in fact develop secondary to an unrecognized organic cause. Even with these difficulties, proper classification is of real

practical import in preventing unnecessary surgery if psychological help is indicated and in preventing unproductive and costly psychotherapy when in fact surgery is appropriate. As is true with other aspects of sexual dysfunction, this has been studied most extensively in men. The nature of the workup depends on the diagnostic facilities available. In all instances, however, the evaluation begins with a careful history and physical examination.

Psychogenic impotence is an affect problem that usually produces selective erectile dysfunction. The episodic nature is evidenced by a history of normal rigid erections in some circumstances but not others; examples include the man who is unable to become erect with some but not all sexual partners, the man with normal erection during masturbation, and the man with normal penile nocturnal tumescence. Anger, guilt, and fear are common problems that preclude erection. The mechanism by which common emotional states cause sexual dysfunction in some men and have no effects in others is not known.

Erectile dysfunction secondary to organic disease generally results in a sequence of gradually deteriorating sexual ability (Table III). An initial decline in

Table III (47, 48)

Clinical Features of Psychogenic and Organic Sexual Dysfunction

	Psychogenic	Organic
Onset	Sudden	Gradual
Course	Episodic in nature; normal nocturnal erections and erections with fantasy or masturbation	Persistent failure with sequential deterioration in hardness and frequency of erection; worsening with fatigue; eventual loss of nocturnal erections and of ability to obtain erections on masturbation
Patient Reaction	Usually believes an organic etiology is causal	Often assumes it is due to a psychological problem

erectile hardness is followed by a decrease in the frequency of erections. Nocturnal erections, erections with masturbation, and sexual erections are usually similarly impaired. All erections then disappear, but sex drive is uninfluenced (except in hypogonadal states). Psychological stress in these patients is usually reactive rather than causative. If organic dysfunction is suspected, then some specific pharmacological, vascular, neurological, endocrine, or organic defect should be sought as the cause of dysfunction, and the history should probe specifically for the presence of known causes of sexual dysfunction (Table I). The workup should include a careful neurological exam and examination of the penis and testes and/or pelvic examination and a baseline endocrine evaluation (measurement of plasma testosterone and prostate in men and assessment of estrogenic status in women at the time of pelvic examination). This workup alone may allow a

diagnosis to be reached in many instances, for example, appropriate drug substitution would be indicated in a man with a history suggesting organic impotence that followed institution of propanalol therapy for cardiovascular disease. Likewise, in rare instances a decision to attempt androgen replacement therapy or the lowering of plasma prolactin is made at this time. In other cases the initial evaluation leads to additional diagnostic testing.

The clinical importance of monitoring nocturnal penile tumescence is not established. However, reliable devices for its measurement are now available for home and hospital use. Presumably establishing total absence of nocturnal penile tumescence is useful and strongly suggests an organic etiology. The finding that nocturnal penile tumescence is present is of less significance -- no matter how it is documented -- unless an assessment of rigidity of the erection is done simultaneously (48). Therefore, it is common when the remainder of the clinical picture suggests an organic cause to proceed to the assessment of the penile vasculature which may involve assessment of penile blood flow itself or radiographic studies of the pelvic and internal pudendal arteries. Presumably, the decision to recommend a surgical prosthesis in men would be made if the erectile failure were due to untreatable vascular, neurogenic, or physical causes or if the nature of the associated systemic disease were such that resumption of an active sex life would not be harmful (e.g. renal failure). In those instances in which the sexual dysfunction is believed to be non-organic in nature, psychotherapy is successful in the majority (34).

REFERENCES

1. Federman DD. Impotence: etiology and management. Hosp Pract 1982 (March); 155-159.

2. Smith AD. Causes and classification of impotence. Urol Clin North Am 1981; 8:79-89.

3. Wagner G. Erection, anatomy. In: Wager G, Green R, eds. Impotence. New York: Plenum Press, 1981, Chap 1.

4. Thomas AJ Jr, Pierce JM Jr. Sexual function. Physiology of male sexual function. In: Harrison JH, Gittes RF, Perlmutter AD, Stamey TA, Walsh PC, eds. Campbell's Urology. Philadelphia: WB Saunders, 1979, Chap 61, 1923-1950.

5. Krane RJ, Siroky MB. Neurophysiology of erection. Urol Clin North Am 1981; 8:91-102.

6. Melman A, Henry D. The possible role of the catecholamines of the corpora in penile erection. J Urol 1979; 121:419-421.

7. Van Arsdalen KN, Malloy TR, Wein AJ. Erectile physiology, dysfunction and evaluation. Part I: Physiology of erection. Monogr Urol 1983; 4:137-156.

8. Benson GS, McConnell JA, Schmidt WA. Penile polsters: functional structures or atherosclerotic changes? J Urol 1981; 125:800-803.

9. Shirai M, Ishii N, Mitsukawa S, Matsuda S, Nakamura M. Hemodynamic mechanism of erection in the human penis. Arch Androl 1978; 1:345-349.

10. Newman HF, Northup JD. Mechanism of human penile erection: an overview. Urology 1981; 17:399-408.

11. Benson GS. Mechanisms of penile erection. Invest Urol 1981; 19:65-69.

12. Newman HF, Northup JD, Devlin J. Mechanism of human penile erection. Invest Urol 1964; 1:350-353.

13. Ruzbarsky V, Michal V. Morphologic changes in the arterial bed of the penis with aging. Relationship to the pathogenesis of impotence. Invest Urol 1977; 15:194-199.

14. Levin RM, Wein AJ. Quantitative analysis of alpha and beta adrenergic receptor densities in the lower urinary tract of the dog and the rabbit. Invest Urol 1979; 17:75-77.

15. Levin RM, Wein AJ. Adrenergic alpha receptors outnumber beta receptors in human penile corpus cavernosum. Invest Urol 1980; 18:225-226.

16. Sjostrand NO, Klinge E. What function have cholinergic nerves in the smooth muscle of the male genital tract? Acta Physiol Scand Suppl 1977; 452:89-90.

17. Benson GS, McConnell JA, Lipshultz LI. Neuromorphology and neuropharmacology of the human penis. An in vitro study. J Clin Invest 1980; 65:506-513.

18. Polak JM, Mina S, Gu J, Bloom SR. Vipergic nerves in the penis. Lancet 1981; 2:217-219.

19. Sjostrand NO, Klinge E, Himberg J-J. Effects of VIP and other putative neurotransmitters on smooth muscle effectors of penile erection. Acta Physiol Scand 1981; 113:403-405.

20. Larsen J-J, Ottesen B, Fahrenkrug J, Fahrenkrug L. Vasoactive intestinal polypeptide (VIP) in the male genitourinary tract. Invest Urol 1981; 19:211-213.

21. Klinge E, Sjostrand NO. Comparative study of some isolated mammalian smooth muscle effectors of penile erection. Acta Physiol Scand 1977; 100:354-367.

22. Kollberg S, Petersen I, Stener I. Preliminary results of an electromyographic study of ejaculation. Acta Chir Scand 1962; 123:478-483.

23. Newman HF, Reiss H, Northup JD. Physical basis of emission, ejaculation, and orgasm in the male. Urology 1982; 19:341-350.

24. Wilson JD. Gonadal hormones and sexual behavior. In: Besser GM, Martini L, eds. Clinical Neuroendocrinology. Chap 1, Vol II. New York: Academic Press, 1982: 1-29

25. Beach FA. Hormonal control of sex-related behavior. In: Human Sexuality in Four Perspectives. Baltimore: Johns Hopkins Press, 1977: 247-267.

26. Bremer J. Symptoms of sex hormone withdrawal. In: Asexualization. New York: MacMillan, 1959, 63-117.

27. Davidson JM, Camargo CA, Smith ER. Effects of androgen on sexual behavior in hypogonadal men. J Clin Endocrinol Metab 1979; 48: 955-958.

28. Bancroft J. Hormones and human sexual behaviour. Br Med Bull 1981; 37:153-158.

29. Skakkebaek NE, Bancroft J, Davidson DW, Warner P. Androgen replacement with oral testosterone undecanoate in hypogonadal men: a double blind controlled study. Clin Endocrinol 1981; 14:49-61.

30. Davidson JM, Kwan M, Greenleaf WJ. Hormonal replacement and sexuality in men. Clin Endocrinol Metab 1982; 11:599-623.

31. Kwan M, Greenleaf WJ, Mann J, Crapo L, Davidson JM. The nature of androgen action on male sexuality: A combined laboratory-self-report study on hypogonadal men. J Clin Endocrinol Metab 1983; 57:557-562.

32. Siiteri PK, MacDonald PC. Role of extraglandular estrogen in human endocrinology. In: Greep RO, Astwood EB, eds. Handbook of Physiology. Vol 7, Sect 7, Chap 28, Washington, DC: American Physiological Society, 1973: 615-629.

33. Wilson JD. Metabolism of testicular androgens. In: Greep RO, Astwood EB, eds. Handbook of Physiology. Vol V, Sect 7, Chap 25. Washington, DC: American Physiological Society, 1975: 491-508.

34. Kolodny RC, Masters WH, Johnson V. Textbook of Sexual Medicine. Chap 1. Boston: Little, Brown and Co, 1979: 1-28.

35. Wagner G, Ottesen B. Vaginal blood flow during sexual stimulation. Obstet Gynecol 1980; 56:621-624.

36. Waxenberg SE, Drellich MG, Sutherland AM. The role of hormones in human behavior. I. Changes in female sexuality after adrenalectomy. J Clin Endocrinol Metab 1959; 19:193-202.

37. Schon M, Sutherland AM. The role of hormones in human behavior. III. Changes in female sexuality after hypophysectomy. J Clin Endocrinol Metab 1960; 20:833-841.

38. Adams DB, Gold AR, Burt AD. Rise in female-initiated sexual activity at ovulation and its suppression by oral contraceptives. N Engl J Med 1978; 299:1145-1150.

39. Abplanalp JM, Rose RM, Donnelly AF, Livingston-Vaughan L. Psycho-endocrinology of the menstrual cycle: II. The relationship between enjoyment of activities, moods, and reproductive hormones. Psychosom Med 1979; 41:605-615.

40. Schreiner-Engel P, Schiavi RC, Smith H, White D. Sexual arousability and the menstrual cycle. Psychosom Med 1981; 43:199-214.

41. Sanders D, Bancroft J. Hormones and the sexuality of women -the menstrual cycle. Clin Endocrinol Metab 1982; 11:639-659.

42. Dennerstein L, Burrows GD. Hormone replacement therapy and sexuality in women. Clin Endocrinol Metab 1982; 11:661-679.

43. Sanders D, Warner P, Backstrom T, Bancroft J. Mood, sexuality, hormones and the menstrual cycle. I. Changes in mood and physical state: Description of subjects and method. Psychosom Med 1983; 45:487-501.

44. Backstrom T, Sanders D, Leask R, Davidson D, Warner P, Bancroft J. Mood, sexuality, hormones, and the menstrual cycle. II. Hormone levels and their relationship to the premenstrual syndrome. Psychosom Med 1983; 45:503-507.

45. Bancroft J, Sanders D, Davidson D, Warner P. Mood, sexuality, hormones, and the menstrual cycle. III. Sexuality and the role of androgens. Psychosom Med 1983; 45:509-516.

46. Hatch JP. Vaginal photoplethysmography: Methodological considerations. Arch Sex Behav 1979; 8:357-374.

47. Vliet LW, Meyer JK. Erectile dysfunction: Progress in evaluation and treatment. Johns Hopkins Med J 1982; 151:246-258.

48. Van Arsdalen KN, Malloy TR, Wein AJ. Erectile physiology, dysfunction and evaluation -- Part II: Etiology and evaluation of erectile dysfunction. Monogr Urol 1983; 4:165-185.

49. Fisher C, Groff J, Zuch J. Cycle of penile erection synchronous with dreaming (REM) sleep. Preliminary report. Arch Gen Psychiatry 1965; 12:29-45.

50. Karacan I, Williams RL, Thornby JI, Salis PJ. Sleep-related penile tumescence as a function of age. Am J Psychiatry 1975; 132:932-937.

51. Wein AJ, Fishkin R, Carpiniello VL, Malloy TR. Expansion without significant rigidity during nocturnal penile tumescence testing: A potential source of misinterpretation. J Urol 1981; 126:343-344.

52. Godec CJ, Cass AS. Quantification of erection. J Urol 1981; 126:345-347.

53. Wasserman MD, Pollak CP, Spielman AJ, Weitzman ED. Theoretical and technical problems in the measurement of nocturnal penile tumescence for the differential diagnosis of impotence. Psychosom Med 1980; 42:575-585.

54. Metz P, Wagner G. Penile circumference and erection. Urology 1981; 18:268-270.

55. Marshall P, Surridge D, Delva N. The role of nocturnal penile tumescence in differentiating between organic and psychogenic impotence: The first stage of validation. Arch Sex Behav 1981; 10:1-10.

56. Kenepp D, Gonick P. Home monitoring of penile tumescence for erectile dysfunction. Initial experience. Urology 1979; 14:261-264.

57. Hahn PM, Leder R. Quantification of penile "buckling" force. Sleep 1980; 3:95-97.

58. Casey WC. "Penile blood pressure" -- a clarification. Urology 1980; 15:47-48.

59. Griffin JE, Wilson JD. Disorders of the testes and male reproductive tract. In: Foster DW, Wilson JD, eds. Williams Textbook of Endocrinology. 7th ed, Chap 10. Philadelphia: WB Saunders, 1984, in press.

60. Perryman RL, Thorner MO. The effects of hyperprolactinemia on sexual and reproductive function in man. J Androl 1981; 5:233-242.

61. Miller JB, Howards SS, MacLeod RM. Serum prolactin in organic and psychogenic impotence. J Urol 1980; 123:862-864.

62. Leriche A, Morel A. The syndrome of thrombotic obliteration of the aortic bifurcation. Ann Surg 1948; 127:193-206.

63. Michal V, Kramar R, Pospichal J. External iliac "steal syndrome." J Cardiovasc Surg 1978; 19:355-357.

64. Amelar RD, Dubin L. Sexual function and fertility in paraplegic males. Urology 1982; 20:62-65.

65. Kalliomaki JL, Markkanen TK, Mustonen VA. Sexual behavior after cerebral vascular accident. A study on patients below the age of 60 years. Fertil Steril 1961; 12:156-158.

66. Bors E, Comarr AE. Neurological disturbances of sexual function with special reference to 529 patients with spinal cord injury. Urol Survey 1960; 10:191-222.

67. Faerman I, Vilar O, Rivarola MA, Rosner JM, Jadzinsky MN, Fox D, Lloret AP, Bernstein-Hahn L, Saraceni D. Impotence and diabetes. Studies of androgenic function in diabetic impotent males. Diabetes 1972; 21:23-30.

68. Campell IW. Diabetic autonomic neuropathy. Br J Clin Pract 1976; 30:153-156.

69. Jevtich MJ, Edson M, Jarman WD, Herrera HH. Vascular factor in erectile failure among diabetics. Urology 1982; 19:163-168.

70. Melman A, Henry DP, Felten DL, O'Connor BL. Alteration of the penile corpora in patients with erectile impotence. Invest Urol 1980; 17:474-477.

71. Karacan I. Diagnosis of erectile impotence in diabetes mellitus. An objective and specific method. Ann Intern Med 1980; 92:334-337.

72. Herman A, Adar R, Rubinstein Z. Vascular lesions associated with impotence in diabetic and nondiabetic arterial occlusive disease. Diabetes 1978; 27:975-981.

73. Madorsky ML, Ashamalla MG, Schussler I, Lyons HR, Miller GH Jr. Post-prostatectomy impotence. J Urol 1976; 115:401-403.

74. So EP, Ho PC, Bodenstab W, Parsons CL. Erectile impotence associated with transurethral prostatectomy. Urology 1982; 19:259-262.

75. Walsh PC, Donker PJ. Impotence following radial prostatectomy: Insight into etiology and prevention. J Urol 1982; 128:492-497.

76. Walsh PC, Lepor H, Eggleston JC. Radical prostatectomy with preservation of sexual function: anatomical and pathological considerations. Prostate 1983; 4:473-485.

77. Lue TF, Zeineh SJ, Schmidt RA, Tanagho EA. Neuroanatomy of penile erection: Its relevance to iatrogenic impotence. J Urol 1984; 131:273-280.

78. Sherman FP. Impotence in patients with chronic renal failure on dialysis: Its frequency and etiology. Fertil Steril 1975; 26:221-223.

79. Horowitz JD, Goble AJ. Drugs and impaired male sexual function. Drugs 1979; 18:206-217.

80. The Medical Letter. Drugs that cause sexual dysfunction. 1980; 22:108-110.

81. Papadopoulos C. Cardiovascular drugs and sexuality. A cardiologist's review. Arch Intern Med 1980; 140:1341-1345.

82. Brindley GS. Cavernosal alpha-blockade: A new technique for investigating and treating erectile impotence. Br J Psychiatry 1983; 143:332-337.

83. Van Thiel DH, Gavaler JS, Sanghvi A. Recovery of sexual function in abstinent alcoholic men. Gastroenterology 1982; 84:677-682.

84. Spark RF, White RA, Connolly PB. Impotence is not always psychogenic. Newer insights into hypothalamic-pituitary-gonadal dysfunction. JAMA 1980; 243:750-755.

85. Melman A, Kaplan D, Redfield J. Evaluation of the first 70 patients in the center for male sexual dysfunction of Beth Israel Medical Center. J Urol 1984; 131:53-55.

86. Schiavi RC. Male erectile disorders. Ann Rev Med 1981; 32:509-520.

87. Viraq R, Ottesen B, Wagner G, Fahrenkrug J. VIP as neurotransmitter in penile erection. Regul Pept 1983; 6:301.

88. Beaser RS et al. Experience with penile prostheses in the treatment of impotence in diabetic men. JAMA 1982; 248:943-948.

89. Furlow WL. Use of inflatable penile prosthesis in erectile dysfunction. Urol Clin North Am 1981; 8:181-193.

90. Narayan P, Lange PH. Semirigid penile prostheses in the management of erectile impotence. Urol Clin North Am 1981; 8:169-179.

91. Levine SB. Marital sexual dysfunction: ejaculation disturbances. Ann Intern Med 1976; 84:575-579.

92. Dennerstein L, Burrows GD. Hormone replacement therapy and sexuality in women. Clin Endocrinol Metab 1982; 11:661-679.