Brief Review

Sexual Dysfunction in Hypertensive Men
A Critical Review of the Literature

SUDHIR BANSAL

SUMMARY Sexual dysfunction is common in hypertensive men and often is first reported by patients while receiving hypotensive therapy, leading to a widespread belief by patients and physicians that the sexual dysfunction is caused by a specific antihypertensive medication. However, it is unclear from the literature whether this problem is related to hypertension or to its therapy. Further, whether the erectile failures reported during therapy are a result of 1) reduced penile blood flow secondary to reduction of blood pressure after antihypertensive treatment or to obstructive vascular disease (or both) or 2) specific drug effects has not been well studied. Because of these unresolved issues, this common problem is not well managed and contributes to noncompliance with therapy by hypertensive male patients, which impedes the attainment of satisfactory blood pressure control. The present article reviews the literature related to hypertension and sexual function in men and outlines a management strategy for clinicians that attempts to document normalcy of sexual function before initiating treatment in newly diagnosed hypertensive patients. Further, it does not ascribe causality to specific antihypertensive agents for the sexual dysfunction reported by treated hypertensive patients but attempts instead to delineate the pathogenesis of the dysfunction. Once the pathogenesis is established, treatment plans can be implemented to restore normotension and maintain adequate sexual function among treated hypertensive men. The article also discusses how applied research in this area may be performed. (Hypertension 12: 1-10, 1988)

KEY WORDS erectile failure • sexual function • impotence • hypertensive men

SEXUAL dysfunction often creates severe emotional distress and may have an adverse effect on a person's overall health. Sexual dysfunction includes problems related to libido, erection, and ejaculation. The high prevalence of sexual dysfunction in hypertensive men is well established. Because the dysfunction is commonly believed to be the result of a specific hypotensive agent, it is usually managed by a change of medications. However, this clinical practice is without an established scientific basis. The assignment of causality of erectile dysfunction to the specific effects of a hypotensive agent is based on data relying on reports of patients to therapists, suffers from patient and therapist bias, and seldom has pretreatment data or adequate controls (or both).

Despite such shortcomings, the studies reviewed in the present report form the basis of both current patient management and future research. A brief description of sexual function in normal persons in included to lay the groundwork for the discussion of sexual dysfunction reported by hypertensive men.

Prevalence of Sexual Dysfunction

The prevalence of sexual dysfunction in hypertensive men needs to be reviewed in the context of sexual function among healthy men. Information about the baseline patterns of sexual functioning in normal men is forthcoming from numerous population surveys. Three of the most often quoted studies focusing on sexual functioning are reviewed. In a pioneering work, Kinsey et al. reported that the prevalence of erectile dysfunction was age-related, being less than 2% until the age of 40 years, increasing to 6.7% by 55 years of age, and increasing to 24% by age 70 years. A recent survey analyzed the voluntary responses of presumably normal London men, aged 20 to 35 years and sexually active in a stable relationship, during a detailed sexual interview. The interviews were conducted at a single session by a trained psychologist and addressed five main areas of sexuality by using 54 separate questions. Erectile difficulties were reported by 8.25% of respondents (8 of 97) during sexual intercourse and by 18.5% (15 of 81) during masturbation.

In a similar vein, the prevalence of sexual dysfunction was identified among couples believed to have a stable marital relationship. The report was based on answers relating to sexual function in a...
15-page self-administered questionnaire addressing numerous issues related to marriage. The mean age of the couples was 35.04 ± 10.07 years for women and 37.42 ± 11.15 for men. In this sample, 7% of men reported difficulties in achieving, and 9% in maintaining, an erection. There was no significant difference between the wife’s perception of the husband’s dysfunction and the husband’s self-report. Further, the men’s reports of difficulty in getting an erection correlated with age, with the older men more likely to experience the problem. This age-related erectile dysfunction probably accounted for the reported decrease in the frequency of sexual intercourse with advancing age. The Baltimore Aging Study, which examined healthy normotensive men between the ages of 60 and 79 years, also reported a progressive decline in the frequency of sexual intercourse with advancing age.

Based on these studies, it can be assumed that about one tenth of normal men under the age of 40 years in a stable, heterosexual relationship are experiencing sexual problems at any time and that the prevalence of this dysfunction rises with advancing age. In contrast to these reports of sexual function among normal men, reports of sexual dysfunction in hypertensive men have usually suffered from lack of specificity, as the data have been collected as part of an overall evaluation of hypertension or its drug therapy (or both).

In this review, the data on the prevalence of sexual dysfunction in hypertensive men are grouped under 1) untreated hypertension, 2) placebo-treated and active drug–treated hypertension, and 3) specific drug–treated hypertension (grouped by mechanisms of drug action). This discussion will help delineate the role of hypertension itself versus the effect of disease labeling and the effect of specific pharmacological agents on the sexual functioning of the hypertensive man.

Untreated Hypertension

Two studies have closely examined sexual functioning in untreated hypertension. 11, 12 The two studies used identical questionnaires that were self-administered by subjects at home and inquired about 20 somatic symptoms commonly associated with hypertension or its drug therapy. The question of sexual function was addressed by asking the subjects whether during sexual intercourse they were a) troubled by failure to obtain an erection, b) troubled by failure to sustain an erection, or c) troubled by failure to pass semen. The answer options were Yes or No. Also inquired about was the frequency of sexual activity11 or the inclination for sexual activity.12 Responses obtained from 99 newly diagnosed untreated hypertensive men referred to a hospital for treatment, 78 normotensive controls drawn from a local general practice, and 477 hypertensive patients undergoing long-term treatment of hypertension were compared in one study. 11 In the three groups, 84, 51, and 82% of the subjects returned the questionnaires, respectively. Erectile and ejaculatory difficulties were reported in a rising order of prevalence as normotensive controls were compared with untreated hypertensive men and with treated hypertensive men (Table 1). Ten months into treatment, the questionnaire was readministered. One of the 17 responding normotensive men had become impotent, whereas the prevalence for 55 drug-treated hypertensive men was unchanged, with an equal number (5) gaining and losing the symptom.

Data collected in the Australian National Blood Pressure Study were the basis for the second report. 12 Patients with mild hypertension (diastolic blood pressure, 95–109 mm Hg) were treated at random with active drug or placebo. Patients initially diagnosed as hypertensive but with subsequent diastolic blood pressures below 95 mm Hg formed a “no tablet” group. One to 2 years after entering the study, patients were given the previously mentioned questionnaire. Of the 820 questionnaires issued, 788 (96%) were returned. The same questionnaire was answered by a randomly selected group of 250 suburban factory workers between 30 and 69 years of age. The final answers were analyzed from 201 hypertensive men receiving active drug treatment, 195 hypertensive men receiving a placebo, 75 patients in the no tablet group (akin to being labeled hypertensive?), and 126 subjects from the normal population. There were no significant differences in the three groups of hypertensive men, including the no tablet group, with regard to sexual complaints, which were more prevalent than in the normotensive controls (Table 1). Although actual data were not provided, a significantly marked decline in performance after 55 years of age was mentioned.

In summary, the prevalence of erectile dysfunction in these two studies among normotensive controls was similar to that in the previously discussed population surveys that were highly focused on sexuality, with about a tenth of normotensive controls experiencing erectile difficulties. The prevalence doubled in both studies when untreated hypertensive men were compared with normotensive controls. However, when a group of normotensive men labeled hypertensive but not receiving medication (no tablet group) was questioned, the prevalence of erectile failures was similar to that among hypertensive men, suggesting the role of disease labeling. Further, though there is information about the worsening of sexual function with advancing age in normal men, the role of aging in hypertensive men has not been well explored.

Placebo-Treated and Active Drug–Treated Hypertension

The prevalence of erectile dysfunction among placebo-treated hypertensive men is variable (3–28%) and may be related to the interviewing technique, as all five of the studies discussed are based on self-report11 using the same questionnaire. 12 Two reports are from the Veterans Administration Coop
SEXUAL DYSFUNCTION IN HYPERTENSIVE MEN/Bansal

TABLE 1. Prevalence of Sexual Problems in Hypertensive and Control Populations

<table>
<thead>
<tr>
<th>Study</th>
<th>No treatment</th>
<th>Placebo</th>
<th>Active drug</th>
<th>Normotensive controls</th>
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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Bulbitt et al.¹¹</td>
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<tr>
<td>First visit</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>17.1 (99)</td>
<td>—</td>
<td>24.6 (477)</td>
<td>6.9 (78)</td>
</tr>
<tr>
<td>E</td>
<td>7.3 (99)</td>
<td>—</td>
<td>25.6 (477)</td>
<td>0 (78)</td>
</tr>
<tr>
<td>Follow-up at 12 mo.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>—</td>
<td>—</td>
<td>15 (52)*</td>
<td>5.9 (17)*</td>
</tr>
<tr>
<td>E</td>
<td>—</td>
<td>—</td>
<td>10 (52)*</td>
<td>0*</td>
</tr>
<tr>
<td>Bauer et al.¹²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>20 (75)</td>
<td>14 (195)</td>
<td>19 (201)</td>
<td>10 (126)</td>
</tr>
<tr>
<td>E</td>
<td>10 (73)</td>
<td>5 (193)</td>
<td>9 (199)</td>
<td>6 (124)</td>
</tr>
<tr>
<td>L</td>
<td>21 (117)</td>
<td>20 (303)</td>
<td>26 (323)</td>
<td>16 (222)</td>
</tr>
<tr>
<td>VA Cooperative Group¹³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>—</td>
<td>28 (46)</td>
<td>29 (62)</td>
<td>—</td>
</tr>
<tr>
<td>Perry¹⁴</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>—</td>
<td>0.6–3.6 (508)†</td>
<td>1.6–12 (504)†</td>
<td>—</td>
</tr>
<tr>
<td>Medical Research Council¹⁵</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>—</td>
<td>8.9 (539)</td>
<td>Thiazide, 16.2 (256); propranolol, 13.8 (239)</td>
<td>—</td>
</tr>
</tbody>
</table>

Values are given as percentages, with the number of subjects in parentheses. I = impotence; E = ejaculatory incompetence; L = decreased libido.

*During 1 year of observation of the 52 hypertensive men, impotence developed in two, was unchanged in 10, and improved in two. Impotence developed in one normal control. Ejaculating dysfunction developed in two hypertensive men, improved in two, and was unchanged in one.

†Data provided are by frequency of the side effect over total number of visits. This has been extrapolated to provide maximum and minimum prevalence based on the number of subjects in each group.

erative Study Group involving men aged 20 to 55 years with mild diastolic hypertension.¹³, ¹⁴ No significant difference in the increased reporting of impotence was seen after inception of placebo or active hypotensive agent in one of these studies (see Table 1).¹³ By contrast, the second study,¹⁴ in a similar population, reported the frequency of impotence was 3.39 times more in active drug–treated versus placebo-treated hypertensive men in over 4000 visits made by 500 subjects in one group. However, the rate of reporting of sexual dysfunction in placebo-treated hypertensive men (0.6–3.6%)¹⁴ is lower than that reported for normal men⁸⁻⁹ or untreated hypertensive men by other authors.¹¹, ¹² Such a low prevalence may be due to “different value judgments used by various clinic physicians”¹³ to diagnose impotence. Similar observer bias might explain the higher prevalence of impotence in active drug–treated as compared with placebo-treated hypertensive men.¹⁵ The study used questions identical to those in the previous studies¹¹ to identify sexual complaints among patients aged 35 to 64 years. The trial was a single-blinded trial and hence open to observer bias. In this study sexual side effects were given as the principal reason for withdrawal from therapy by hypertensive men. The previously mentioned Australian study¹² reported a similar prevalence of erectile dysfunction in the placebo-treated and active drug–treated hypertensive men.

Based on the data reviewed, there is no definite evidence of an increased prevalence of sexual dysfunction in treated hypertensive men as compared with untreated hypertensive men. Despite this literature the majority of authors and conventional wisdom suggest that hypotensive therapy is an important cause of sexual dysfunction.¹⁻³⁻⁵ However, a recent authoritative publication on impotence mentions sexual dysfunction due to side effects of medications as “an area in need of considerable research,”¹² as all of the drug studies depend solely on patients’ self-report and none use objective methodology. A review of studies on impotence and hypotensive therapy reveals that the majority of the studies have merely reported the prevalence of dysfunction with the agent in question and have not compared it with the prevalence of dysfunction in untreated hypertensive controls.

Diuretics

As a diuretic, spironolactone is unique due to its antiandrogen actions and resultant sexual complaints.²² Thiazides¹⁵, ¹⁵₈, ¹⁷ and chlorthalidone¹⁷ have both been implicated as causing sexual problems in hypertensive men. The reported incidence of erectile dysfunction due to diuretics varies from 3 to 32%.⁵, ¹⁶ Erectile difficulties experienced while receiving a thiazide diuretic (bendrofluazide) by men with mild hypertension between the ages of 35 and 64 years was the most frequent principal reason given for withdrawal from hypotensive therapy (19.58 times per 1000 patient-years) in the Medical Research Council trial.¹⁵ Further, withdrawal from therapy returned sexual function to normal. The combination of diuretic and other hypotensive agents has been reported to be associated with a higher
TABLE 2. Prevalence of Sexual Problems in Studies Comparing Two or More Hypotensive Agents

<table>
<thead>
<tr>
<th>Study</th>
<th>Diuretic</th>
<th>Methyldopa</th>
<th>Clonidine</th>
<th>Propranolol</th>
<th>Prazosin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauer et al.15*</td>
<td>1 Single</td>
<td>20 (10)</td>
<td>—</td>
<td>11 (20)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>20 (160)</td>
<td>20 (60)</td>
<td>23 (70)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>E Single</td>
<td>9 (57)</td>
<td>0 (10)</td>
<td>7 (30)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Combination</td>
<td>9 (160)</td>
<td>7 (60)</td>
<td>10 (70)</td>
<td>—</td>
</tr>
<tr>
<td>Medical Research Council13</td>
<td>12 wk</td>
<td>16.2</td>
<td>—</td>
<td>—</td>
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<tr>
<td></td>
<td>2 yr</td>
<td>22.6</td>
<td>—</td>
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<tr>
<td>Bulpitt et al.16</td>
<td>I</td>
<td>—</td>
<td>—</td>
<td>13.8</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>—</td>
<td>—</td>
<td>13.2</td>
<td>—</td>
</tr>
<tr>
<td>Wartman5</td>
<td>I</td>
<td>31.8 (22)</td>
<td>35.7*,† (84)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>13.6 (22)</td>
<td>18.5*,† (84)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Hogan et al.17</td>
<td>Not actually studied</td>
<td>3–9</td>
<td>14–33</td>
<td>11–25</td>
<td>13–23</td>
</tr>
<tr>
<td>Newman and Salerno18</td>
<td>0</td>
<td>26 (27)</td>
<td>—</td>
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<td>—</td>
</tr>
<tr>
<td>VA Cooperative Group19</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>12.8% (229)</td>
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<tr>
<td>VA Cooperative Group20</td>
<td>—</td>
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<td>—</td>
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<tr>
<td>Hollifield20*</td>
<td>I</td>
<td>—</td>
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<tr>
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<td>R</td>
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<tr>
<td></td>
<td>—</td>
<td>0 (40 on 160 mg)</td>
<td>—</td>
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<tr>
<td></td>
<td>—</td>
<td>18 (11 on 320 mg)</td>
<td>—</td>
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<td>—</td>
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<tr>
<td></td>
<td>—</td>
<td>27 (11 on 320 mg)</td>
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</tr>
</tbody>
</table>

Values are reported as percentages, with the number of subjects in parentheses. If not specified, prevalence is of impotence or unspecified sexual difficulty. I = impotence; E = ejaculatory dysfunction; R = reduced libido.
*Combined with diuretic.
†Two or more drugs.

incidence of impotence (20%) than is diuretic agent therapy alone (14%). The majority of studies discussed focused on men with mild hypertension, but they failed to look at the results by age, associated disease states, or severity of the hypertension.

Sympatholytic Agents

As erectile processes are mediated by sympathetic nerve impulses, it is not surprising that hypotensive agents with sympatholytic actions have been frequently implicated as a cause of erectile or ejaculatory dysfunction (or both).

α-Methyldopa

Disorders of sexual function were reported by seven of 27 patients aged 43 to 64 years receiving 500 to 2000 mg of methyldopa a day. The complaints of sexual dysfunction started within a few days of commencing therapy, and these undesirable side effects disappeared within 2 weeks of discontinuing the drug and instituting hydralazine and propranolol therapy. No dysfunction was identified in 22 thiazide-treated hypertensive men by employing similar questioning techniques. A similar prevalence in an earlier report (36%) of 219 patients was thought to be unrelated to drug therapy as it was identical to the prevalence in 51 diuretic-treated patients. In a more detailed analysis of sexual difficulties associated with the inception of methyldopa therapy, sexual difficulties were reported to be dose-related. There were no significant age differences among the patients on different doses. However, an age comparison of patients with and without problems was not undertaken. Management strategies consisted of decreasing the dose of methyldopa and supplementing it with hydralazine or propranolol. The study neglected observer bias and therapist-pleasing attitudes on the part of patients and did not take into account the incidental transmittal of information about managing sexual problems.

Clonidine

Clonidine, a central sympathetic outflow inhibitor, is widely advertised to have a few or no sexual side effects. This claim is based on a low prevalence (10%) of sexual side effects reported during the initial 2 weeks of an 8-week course of therapy. This report is disputed by others reporting a higher prevalence of impotence (Table 2). Propranolol

Propranolol has been the major β-blocker used in hypertension control, and the majority of reports dealing with erectile failures due to β-blockade relate to propranolol. Whether the newer β-blocking drugs, especially those with selective actions, share this side effect is not clear. An initial report of the adverse effects of propranolol on sexual function suggested this effect to be central in origin as it was not observed with atenolol in a patient who had reported propranolol-associated erectile failure. The reports that propranolol-induced impotence occurred in 11% of patients when the drug was used singly and in 23% when used in combination were not substantiated by the Veterans Administration Cooperative Study Group, which reported a 12.8% incidence of impo-
tence whether the drug was used alone or in combination. In a study of 46 male patients with no history of sexual dysfunction, 15% reported complete erectile failures while taking a mean daily dose of 143 mg/day; 28% complained of decreased frequency and quality of erections with 124 mg/day, and those with no sexual complaints were taking a mean daily dose of 83 mg/day. The dose increase resulted in a greater incidence and progressive worsening of erectile failure, with a threshold effect around 160 to 180 mg/day. Sexual side effects of propranolol accounted for 5.48 withdrawals/1000 patient-years in the Medical Research Council trial.

Other Sympatholytic Agents
In the past, an extremely high incidence (50–100%) of sexual dysfunction has been reported with drugs such as guanethidine and reserpine. Due to their uncommon clinical usage, the agents will not be discussed further. A large number of adrenergic receptor blocking drugs have been introduced lately; however, their effects on sexual functioning have not been well studied.

Vasodilators
The use of vasodilators was thought to be unrelated to impotence until an early report of hydralazine-associated impotence that was remitted with withdrawal of therapy and recurred on rel challenge with the drug. In a double-blind study, sexual difficulties were reported frequently after inception of prazosin or hydralazine therapy in hypertensive patients receiving thiazides and were relatively more common with prazosin treatment (see Table 2). By contrast, 15 of the 19 (79%) hypertensive diabetic male patients who had been experiencing impotence on methyldopa or clonidine noted improvement of sexual function when blood pressure control was achieved by prazosin in an open trial of the drug. Four hypertensive patients had normal nocturnal penile tumescence (NPT) measurements during placebo and prazosin treatment as compared with reduced NPT measurements during methyldopa treatment.

Summary of Prevalence
Hypotensive agents as a group of drugs are most likely to be associated with erectile failures. Since untreated hypertensive men may have a higher incidence of sexual dysfunction than normotensive controls have, it is not clear from the reported studies whether the impairment in the patients at risk is due to the drugs, the influence of the disease, or both. Furthermore, as discussed, the reported prevalence of sexual dysfunction in relation to individual drugs is variable and at times similar for two drugs despite their different modes of hypotensive action. However, clinical experience suggests that drug treatment may increase the prevalence of erectile failures in hypertensive patients.

Mechanism of Normal Sexual Function
Normal male sexual function depends on the functional integrity of neural (central and peripheral), vascular, and hormonal processes (Figure 1). Penile erections are based on the development of intracavernous pressure close to the mean arterial pressure (85–105 mm Hg) as a result of engagement of the spongy penile vascular spaces with blood. Shirai et al. demonstrated that the amount of blood accumulated in the penis during the erect state ranges from four to 11 times that present in a flaccid state. The hemodynamic changes that account for this increased penile blood volume could result from an increased arterial inflow or a decrease in the venous drainage (or both). Based on histological studies, Conti proposed that blood accumulation in the penis resulted from blood being shunted from penile somatic tissues to the spongy cavernous bodies as a consequence of the opening of arteriolar muscular sphincters called "polsters" and closing of the venous sphincters (polsters). Subsequent studies performed on cadavers and in normal volunteers with saline infusion and Xenon-133 have suggested that penile erections are primarily a result of increased arterial inflow due to vascular dilatation. Blood arriving in this fashion is preferentially shunted to the low pressure, high volume cavernous tissue, which actively relaxes during this phase. Accumulation of blood in this tissue is facilitated by venous obstruction, which is initially active and partial but becomes complete as the cavernous tissue pressure increases, causing venular collapse.

The neural centers controlling these hemodynamic changes are located in the sacral parasympathetic (S2 to 4) and the thoracolumbar sympathetic (T10 to L2) ganglia. Pelvic nerves originating from the parasympathetic neurons join the hypogastric
nerves arising from the sympathetic ganglia and supply the penile tissues through the pelvic plexus. The two pathways act synergistically but respond to different afferent stimuli (see Figure 1). The putative neurotransmitters released in response to the activation of these pathways include acetylcholine, catecholamines, and the vasoactive intestinal polypeptide. Further, a facilitatory role is played by hormones, especially testosterone, in the mediation of erotic imagery or the recall of the pleasure associated with erections and subsequent sexual activity. Although the role of normoprolactinemia in maintaining normal sexual function is unclear, the disruptive role of hyperprolactinemia on this function is well accepted.

**Mechanism of Sexual Dysfunction in Hypertension**

The impotence seen in hypertensive men is probably the result of alterations in a number of the processes involved in normal sexual function. However, the possible role of each of these processes in the sexual dysfunction of hypertensive men will be discussed individually.

**Psychogenic Factors**

On being labeled hypertensive, patients are confronted with the fact that they suffer from a chronic disease and carry a high risk of heart attack, stroke, or kidney failure. This factor, along with the knowledge that having high blood pressure may require life-long therapy, affect insurance rating, and reduce job opportunities, provides patients with multiple psychological reasons for impaired sexual performance. This may be one reason why hypertensive patients report a higher prevalence of dysfunction when compared with normotensive controls. However, when the psychological features of free-floating anxiety, phobic anxiety, depression, obsession, somatic complaints, and hysteria were examined in hypertensive men, they were found to be unrelated to sexual complaints of decreased libido, impotence, and ejaculatory failure. Thus, despite the suggestions from prevalence studies, there is no direct proof that psyche plays a major role in the sexual dysfunction experienced by hypertensive men.

**Neurogenic Factors**

Normal erectile function requires an intact central and peripheral autonomic nervous system. Furthermore, monoamine transmitters have been established in animal experimentation and are suggested in human studies to play a key role in mediating sexual desire. Involvement of monoamine pathways in the central nervous system may be the basis for essential hypertension and may cause sexual dysfunction in untreated hypertensive men. This mechanism may explain the high prevalence of impotence in untreated hypertensive men compared with normotensive controls. Furthermore, hypotensive drugs that act by alterations of neurotransmitters (central and peripheral) may cause sexual dysfunction as a side effect by affecting libido or altering neural mediation of erectile processes (or both). Interestingly, short-term administration of sympatholytic agents to healthy normotensive volunteers did not interfere with penile blood flow or ability to become erect on erotic exposure. It is not clear whether this lack of effect was due to short-term exposure to the drugs or whether interference with the ability to obtain penile erections is specific to hypertensive patients.

**Hormonal Factors**

Hormones influencing the erectile processes are mainly testosterone, prolactin, and gonadotropins (luteinizing hormone). Although some studies have revealed no abnormalities of these hormone levels in hypertensive patients receiving pharmacotherapy, others have shown elevated prolactin levels in patients taking reserpine and methyldopa. Clonidine, on the other hand, has been shown to reduce prolactin levels. Whether drug-induced altered prolactin levels play a role in sexual dysfunction is unclear.

**Hemodynamic Factors**

Penile erections are primarily a hemodynamic process and result from a net increase in the inflow of blood to the penis. Therefore, it is possible that the high incidence of sexual dysfunction reported in untreated hypertensive men is due to an alteration of the hemodynamics that exist in hypertension. Furthermore, hypotensive drug therapy designed to reduce the systemic blood pressure may interfere with the intracavernous pressure elevation necessary for sustained penile erection. If either of these options were true and altered hemodynamics (primary or drug-induced) were the basis of sexual dysfunction in all or some hypertensive men, then it could be reasoned that it would not be possible to lower blood pressure without losing erectile competence for that subpopulation of hypertensive men. Ambulatory recordings of heart rate and blood pressure show wide fluctuations during sexual activity, occasionally reaching very high levels, especially among hypertensive persons. If the hypotensive agents prevent such cardiovascular responses, they may interfere with obtaining or sustaining a penile erection (or both). However, in the previously mentioned study β-blockers did not interfere with heart rate and blood pressure fluctuations associated with coital activity.

In summary, several factors may have a role in the sexual dysfunction of hypertensive men, but the studies available do not allow us to state which factors play key roles. Important in this regard are vascular, neurogenic, and psychogenic factors.
Management

It should be clear from the preceding discussion that the literature on this topic is conflicting and biased. But clinicians have to respond to hypertensive patients with sexual complaints requesting treatment. From a practical viewpoint, management of dysfunction should be based on an analysis of its pathogenesis, keeping in mind the following guidelines:

A detailed sexual history should be obtained in patients with new onset hypertension before initiating drug therapy.

The sexual complaints of patients on medications are not necessarily a drug side effect.

The least number and lowest dose of blood pressure medications should be used to manage hypertensive patients.

Patients not taking hypotensive medications because of side effects should be followed up regularly.

An analysis starts with a detailed interview by a trained and skilled health professional to elicit accurate information and gather subtle points from both the patient and his sexual partner. Symptoms may be elicited by using the following format of questions:

Positive responses suggest organic cause:
- Erections less than full during coitus
- In early morning during masturbation
- In all sexual and asexual situations
- Adequate erections during foreplay lost before intromission
- Presence of underlying medical illness
- Ejaculatory complaints

Positive responses suggest psychogenic cause:
- Full erections during foreplay, masturbation, sleep or in early morning
- Sexually nondemanding situations
- Abrupt onset
- Decreased desire (rule out endocrine-related cause)

Quite apart from establishing a trusting relationship and rapport with the patient, such historical data may provide clues to the cause of impotence. At this stage, factors contributing to the sexual dysfunction, unrelated to hypertension, should be identified and treated.

The history should be followed by a targeted physical examination, with special attention to peripheral vascular disease, testicular size, fibrotic plaques on the penis, and stigmata of hypogonadism. The algorithm in Figure 2 then may be used to render two groups of patients: 1) those with blood pressure controlled and sexual function maintained (this group needs ongoing monitoring), and 2) those with persistent sexual complaints a) with single or combination drug regimens or b) without drugs. This group requires detailed sexual evaluation and plans for follow-up care (Figure 3).

The algorithm in Figure 2 renders the final two groups in the following manner. Patients with sexual complaints who are not receiving hypotensive therapy should have a detailed sexual evaluation prior to initiation of such therapy. This strategy avoids the confounding influence of hypotensive therapy on the various tests. Patients whose sexual function is noted to have been adversely affected after initiation of hypotensive medications should have the medications withheld for a trial period (if possible) and should be assessed if sexual potency...
returns. If sexual potency is restored, it may be assumed that the drug or drugs in question were causing sexual dysfunction. Some patients may even remain normotensive after the hypotensive treatment is withheld. These patients can be maintained off drugs and periodically evaluated.

In patients in whom sexual potency returns after discontinuation of hypotensive therapy but blood pressure rises and in patients for whom the discontinuation of medications is medically contraindicated, an alternative hypotensive agent with a different mechanism of action can be tried. Although this opinion has been questioned, it has been suggested that the frequency of sexual dysfunction may be lower with certain agents. A subgroup of patients do achieve restoration of sexual functioning when a different hypotensive agent is tried, but the change to a different medication regimen still results in sexual dysfunction for many. These patients and the group in whom sexual complaints persist on discontinuation of therapy need to have a detailed evaluation to design a treatment plan for management of the sexual dysfunction (see Figure 3).

It is of paramount importance to document the history of sexual function in hypertensive patients before starting therapy. If normal sexual function has been documented and impotence develops on initiating hypotensive therapy, the drug can be implicated as the culprit.

**Evaluation of Sexual Function**

To distinguish between organic and psychogenic dysfunction (see Figure 3), self-administered personality questionnaires may be used. Two of the most frequently used instruments are the Minnesota Multiphasic Personality Inventory and the Dero-

The presence of intact nocturnal erectile responses in a patient with erectile complaints establishes a diagnosis of psychogenic impotence. These patients may improve with reassurance and a better understanding of the hypertensive drugs; unresponsive patients may require referral for formal sex therapy. Although the absence of nocturnal erections is strong evidence of organic dysfunction and a need for endocrine, vascular, and neurological evaluation, the reliability of the NPT test has been questioned.

Endocrine evaluation should include measurement of testosterone and prolactin and at times may require multiple blood samples. Adrenal and thyroid functions should be checked in clinically appropriate cases. Low levels of testosterone require an evaluation of the hypothalamic-pituitary-gonadal axis and replacement with testosterone therapy. Patients with elevated prolactin levels need to have a pituitary tumor excluded and should be treated with drugs or surgical procedures if indicated. Although impotence may be the presenting symptom of diabetes, the erectile dysfunction seen in diabetics is frequently of vascular or neurological origin (or both).

In patients with abnormal NPT and normal hormonal levels, penile blood flow studies should be performed. Vascular assessment should ideally include both arterial inflow and venous outflow measurements. Arterial inflow is usually established by a comparison of penile blood pressure (obtained by Doppler ultrasound) to brachial pressures. Values close to unity indicate good penile flow, whereas values below 0.7 are indicative of poor flow. Contrast radiography may be used to establish the site and nature of arterial obstruction. Plethysmographic evaluation, Xe washout, and high resolution ultrasonography improve diagnostic accuracy, but these techniques are not routinely available. Venous leakage or increased outflow may be suspected clinically (short-lived erections, confirmed with NPT), but cavernosography and cavernosometry are required for proof. Surgical repair of inflow or outflow problems may restore normal sexual function in selected patients. Absence of vascular problems suggests neurologically based organic dysfunction and may be supported by abnormal thresholds to electric shock or prolonged sacral nerve reflex latency time (or both).

**Treatment of Sexual Dysfunction**

Therapeutic options remain limited despite the numerous methods available to determine the cause of erectile dysfunction in a given patient. A subgroup of patients with nonendocrinological organic dysfunction responds to orally administered yohimbine, an \( \alpha \)-adrenergic antagonist. Despite yohimbine's modest effect, it may be tried initially due to its ease of administration and safety. In patients not responding to yohimbine, papaverine hydrochloride, a potent vascular smooth muscle relaxant, may be used alone or in combination with phentolamine. The drug or drugs are injected into one of the cavernous bodies on each occasion that sexual intercourse is desired and should be used under close physician supervision. If there is failure to achieve adequate penile rigidity, the possibility of a surgically implantable penile prosthesis should be considered. Implant surgery should be performed after careful psychological screening of the patient and his sexual partner. For patients who refuse to take hypotensive drugs because of their possible effect on sexual function, measures to reduce cardiovascular risks, such as cessation of smoking, normalization of body weight, control of serum cholesterol, and reduction of salt intake, should be attempted. Target organ damage in these patients should be assessed periodically.
Research Needs

There is a great need for research in the area of sexual function and hypertensive therapy. Clinical studies should be specifically designed to explore one or more of the following issues:

The relationship of sexual dysfunction to the nature of hypertensive disease, in terms of the severity, chronicity, age of the patient, or presence of vascular disease in other organ systems should be evaluated. These variables should be used to establish patient groups within a hypertensive population who may be more prone to experience sexual problems.

Sexual functioning should be thoroughly evaluated using valid and standardized tools of interrogation and corroborated by objective methodology such as penile blood flow studies, NPT recording, hormonal status, and neurological assessment. Attention should be paid to libido, erectile competence, and ejaculatory competence as separate but related variables.

Drug studies should be prospective, double-blind, and preferably crossover and have placebo controls. If feasible, rechallenge with the offending drug should be carried out.

Limited studies on the effects of single-dose hypotensive agents in a normotensive population have been performed, but similar studies in larger groups and with longer exposure may be revealing.

This research methodology is available and needs to be applied to improve understanding of sexual function in normal men and sexual dysfunction in hypertensive men. A better understanding of these issues will lead to better patient management and contribute to the overall health and well-being of the hypertensive patient.

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