AMERICAN ACADEMY OF NEUROLOGY

ASSESSMENT: NEUROLOGICAL EVALUATION OF MALE SEXUAL DYSFUNCTION

Report of the Therapeutics and Technology Assessment Subcommittee
of the American Academy of Neurology

Overview. Male sexual dysfunction includes disorders of libido and of erectile and ejaculatory function. Erectile dysfunction or impotence is a common symptom in many neurologic diseases. Peripheral neuropathies,[1-3] cauda equina syndrome,[4-6] pelvic and pudendal nerve lesions,[7,8] and spinal cord trauma and diseases[4,9-12] as well as many disorders of higher brain centers, such as trauma, parkinsonism, Alzheimer's disease, multiple sclerosis, and cerebrovascular insufficiency, are common causes of sexual dysfunction.[13-18] Furthermore, vascular abnormalities, many drugs, and psychological disorders associated with disturbance of neurologic or neuromuscular function may also be associated with impotence.[19-23] These facts have led to the increasing involvement of the neurologist in the evaluation of impotence.

There are now several increasingly effective surgical and nonsurgical methods of treating impotence. The effectiveness and therefore the selection of treatment in an impotent patient is, in part, dependent on the diagnosis. Recent studies showing that intracorporeal injection of vasoactive substances is effective in producing erections have, in many ways, altered the traditional diagnostic approach while offering treatment that had not previously existed. For example, intracorporeal injection of papaverine was noted[24-26] to be more effective in neurogenic impotence. A functional erection produced by this procedure in effect rules out a vascular cause of impotence and the need for vascular diagnostic studies or vascular surgery.[22,27,28] Demand for more accurate diagnostic tools for evaluating impotence has increased the use of many of these tools within the field of neurology.

The neurologist is often the primary physician the impotent patient depends upon for diagnosis and advice. In impotent patients, failure to address the issue of sexual dysfunction may adversely affect the patient's quality of life. Increasingly, however, patients are being referred specifically for the neurologic investigation of impotence, ejaculatory disturbances, and anorgasmia with the following question—is this patient's sexual problem neurologic? Although the primary causes of ejaculatory disturbances such as retrograde ejaculation and secondary organic anorgasmia—the inability to achieve orgasm—may be neurologic, this review will concentrate on the evaluation of erectile dysfunction.

The neurologic evaluation. The evaluation of sexual dysfunction requires close cooperation between the neurologist, urologist, gynecologist, endocrinologist, and psychiatrist as well as other specialists when indicated. As in any neurologic diagnostic process, an accurate history and physical examination are essential in the evaluation of the impotent patient. In this situation, greater emphasis on psychological background, general health and endocrine factors, and bladder and bowel function, as well as a detailed sexual history, is necessary.[29,30] The neurologic examination should include sacral dermatome and genital sensory evaluations and the examination of rectal sphincter function as well as bulbocavernosus and cremasteric reflex testing.[30]

The standard laboratory examination includes CBC count, urinalysis, BUN, fasting blood sugar, cholesterol, testosterone, prolactin, thyroid function, luteinizing hormone, and follicle-stimulating hormone.[28,29] Other tests may be necessary in particular patients.

Testing for specific neurologic diseases and lesions may include any of the standard neurologic tests. Testing for autonomic dysfunction and basic psychological and cognitive functions may also be important. The indications for these tests in the impotent patient do not differ from indications in patients with other neurologic disorders and should be guided by the history and physical examination.

It should be pointed out that the neuronal mechanisms for erectile function in humans have not been adequately studied. Although animal research suggests that the autonomic nervous system, and particularly the sympathetic nerves, plays an important role in penile erection, the evidence that this is true in humans is scant. There are, in fact, several observations that support the role of pudendal nerves in erectile as well as ejaculatory function.[31-33] These studies suggest that sectioning of the pudendal nerve with intact autonomic innervation can

produce abnormalities in male sexual function. This may partially explain why impotence is a frequent problem in diabetes without other evidence of autonomic neuropathy.[34]

Specific neurologic testing for impotence. Diagnostic testing for impotence and other sexual dysfunction can be divided into endocrine and metabolic studies, vascular insufficiency studies, psychological tests, electrodiagnostic studies, and basic tests for erectile capacity. The neurologist is commonly called upon to make a diagnosis as to the presence and location of a neurologic lesion responsible for impotence. Endocrine, metabolic, vascular, and psychological testing are commonly performed by other specialists or ordered by the neurologist in a multidisciplinary team. However, a number of tests fall primarily within the realm of the neurologist and are particularly valuable in determining the presence and nature of a suspected neurologic cause of impotence. These tests can be divided into those that measure erectile function and those that measure neurologic function directly.

1. *Nocturnal penile tumescence and rigidity.* The measurement of nocturnal penile tumescence and rigidity (NPTR), when optimally applied, is a safe, effective, and established method of defining erectile function. The effectiveness in monitoring NPTR varies depending on the method used.

    a) *The postage stamp test, Poten test, and Snap-Gauge screening test* are low-cost, simple screening devices that can be carried out in the home but that give only presumptive information on the ability to obtain nocturnal erections.[35-37] Wrapped around the flaccid penis and pasted or fastened at bedtime, these devices give probable evidence of nocturnal erections if found broken in the morning. These tests have limited diagnostic value, although lack of breakage of the stamp or Poten test or breakage of none or only one of the Pliofilm elements of the Snap-Gauge test suggests organic impotence.[38-4l] The Snap-Gauge test placed at the base and coronal sulcus of the penis is an attempt at quantitative evaluation of erectile ability and penile rigidity.[39,4l] These tests, however, cannot measure the frequency of erections, and since they rely on penile circumferential measurements only, their validity in measuring the quality of erections is questionable.[42]

    b) *Standard nocturnal penile tumescence evaluation using mercury strain gauges* in a sleep laboratory has been the most commonly used test for differentiating psychogenic from organic impotence.[43,44] Reports indicate[43,44] an accuracy of 85 to 90% in measuring erectile capacity but with 15 to 20% false-positive results. This method measures penile expansion but, unfortunately, is incapable of evaluating rigidity.[45,46] This shortcoming can be overcome by direct visual inspection and measurement of buckling force or rigidity.[23,47] Direct visual monitoring together with NPT testing and EEG confirmation of rapid eye movement (REM) sleep is considered the most accurate but also the most expensive method of evaluating erectile function.[47-49] False-negative results have been reported and may be due to differences in the erection capacity that occurs during sleep and that occurring on penile stimulation. False-negative results may also be due to the difficulties of sleeping under laboratory conditions.[50]

    c) *Continuous monitoring of nocturnal penile tumescence and rigidity. A* commercial rigidometer is now available for monitoring both circumference and rigidity.[45,46,5l] Reports indicate that the use of the rigidometer reduces the number of false-positive and false-negative NPT tests.[51] This procedure has the advantage of being performed at home when sleep is more likely to be normal. Penile rigidity can also be measured using this device with the patient awake and undergoing visual sexual stimulation,[23] or during napping.[52]

        NPTR testing, however, does not determine the cause of impotence, which can be psychogenic, neurogenic, vascular, metabolic, or due to a combination of factors. Discrepancies have been found[42,48,53-55] between NPTR monitoring and the presence of impotence, and other tests for impotence as well as patient-partner self-reporting.

2. *Erectile capacity.* Differentiating neurogenic and psychogenic impotence from vascular causes of impotence can be achieved by the intracorporeal injection of smooth muscle relaxants.[25,46,56] A quick rigid erection following these injections is thought to be strong evidence for neurogenic impotence. A1though a number of drugs induce erections on intracorporeal injection, the most widely used agents are papaverine, a papaverine-phentolamine combination or, more recently, prostaglandin E_l.[57,58] The exact mechanism of action of these

drugs has not been clearly established. The combination of injection and self-stimulation has been recommended as a method of increasing the sensitivity of this test.[28] Up to 70% of patients are reported to achieve better erections with this technique than with injection alone.[28] The failure of erection following such injections is strong evidence for a vascular, particularly venous, insufficiency as the cause of impotence.[59] If the papaverine causes an erection in an impotent patient, then additional testing for neurologic and psychogenic causes of impotence may be required.[36] Alternatively, patient and physician may opt for this form of therapy.[30] Firm erections rapidly followed by various degrees of detumescence suggest venous leakage.[26,60]

Complications are rare with single test injections but can include priapism, transient local paresthesia, hematoma, infection, and fibrosis in the penile shaft.[36,61] Priapism can be treated with an injection of alpha-adrenergic drugs (eg, metaraminol) or, occasionally, aspiration of blood from the corpora. Fibrosis may be related to the frequency of injection and can be reversed by discontinuing injections.[29,36] Intracorporeal injection of vasoactive drugs is, however, a technique that has diagnostic value and is considered 90% effective in excluding venous insufficiency as a cause of impotence.[60]

3. *Penile and pudendal nerve conduction.* When neurogenic impotence is suspected, it becomes necessary to confirm the diagnosis and attempt to localize the lesion within the nervous system. Lower-extremity nerve conduction studies and evoked potentials may help determine the presence of a peripheral neuropathy or spinal cord lesion.[3,62] These tests, however, do not measure neural mechanisms directly involved in sexual function. Results from lower-extremity nerve conduction studies cannot be readily extrapolated to penile nerves. This observation has led to the development of a series of tests that measure penile and pudendal nerve conduction directly. These tests are well tolerated by patients.

    a) *Penile nerve conduction velocity.* The direct measurement of penile nerve conduction by recording over the distal shaft of the penis on stimulation of the proximal shaft is safe and easily performed.[63,64] Patients with diabetic neuropathy have an abnormal test result. Penile nerve conduction, although not yet studied extensively, holds promise for the investigation of penile neuropathies.

    b) *Bulbocavernosus reflex response.* This is the most widely studied of the pudendal nerve conduction testing methods. It is a safe, effective, and established method of documenting pudendal neuropathies and cauda equina injuries that can cause impotence[15,36,63,65,66] It is performed by stimulating the dorsal nerve of the penis and recording over the perineum or rectal sphincter.[17,67-69] By stimulating the proximal and distal shaft of the penis, it is possible to measure penile nerve conduction velocity indirectly.[70] This test has been demonstrated to correlate with impotence in patients with diabetic neuropathy,[70,71] patients with multiple sclerosis with conus demyelination,[72] and patients with alcoholic neuropathy.[15] The test does not, however, measure conduction in the autonomic component of erectile function. Therefore, it correlates only with those disorders of the pudendal nerve associated with impotence. Bulbocavernosus reflex latency may be abnormally prolonged in men with normal erectile function[73] and has been described as normal in some patients who have peripheral neuropathy and impotence of unknown cause that is thought to be neurogenic.[34,74]

    c) *Pudendal somatosensory evoked responses.* Somatosensory evoked potential (SSEP) responses on electrical stimulation of the penis is a safe, effective, and established method of evaluating primary sensory pathways from the penis via the pudendal nerve.[15,17,36,75] Patients with diabetic peripheral neuropathy, spinal cord injuries, or multiple sclerosis have abnormal SSEPs.[18,62,70,72,75] In patients with suspected neurogenic impotence in whom a thorough history and neurologic examination are unrevealing, the combined use of bulbocavernosus reflex and pudendal SSEP testing with cystometry and NPT can differentiate between impotence from higher motor neuron disease, spinal cord lesions, and perineuropathies.[17,75] However, one study[76] in 29 patients with spinal cord lesions found the same proportion of abnormalities when the pudendal SSEP was compared with the peroneal SSEP.

    Although electrodiagnostic testing is important in defining neurologic lesions that can cause sexual dysfunction, the sensitivity and specificity of these tests in the detection of impotence have not been established. The autonomic nervous system is in all probability at least as important as the somatic nervous system in the production of penile erections. At this time, there is no direct method of measuring autonomic innervation of penile structures.

Pudendal nerve function appears to be more important in the evaluation of penile sensation and ejaculation. The bulbocavernosus reflex is considered analogous to the ejaculation reflex. The ability to measure bulbocavernosus reflex responses and pudendal SSEPs in women make this the only test with the potential of measuring organic neurologic disturbances that would result in anorgasmia.

4. *Penile biothesiometry.* This inexpensive and simple test measures the vibration perception threshold of the penis. Fairly good correlation has been noted between biothesiometry and electrodiagnostic testing, although the latter is considered more diagnostic of neurologic deficiency.[15,65,77] The effectiveness of this test in documenting neurogenic impotence has not been established but is considered promising as a potential screening test.

Conclusions.

1. *The evaluation of neurogenic causes* of impotence is an integral part of the practice of neurology. Close cooperation with specialists in urology, endocrinology, psychiatry, and other related fields is often necessary to evaluate and treat patients presenting with impotence.

2. *When evaluating patients* with impotence, the neurologist utilizes basic history and neurologic examination methods with greater emphasis on the neurologic evaluation of bowel, bladder, and sexual organ function. Standard imaging and electrodiagnostic studies of the nervous system may be necessary to localize intracranial, spinal cord, or peripheral nerve lesions that cause impotence or other sexual dysfunctions.

3. *The measurement of NPTR is* a safe method of evaluating patients with impotence. The sensitivity and specificity are dependent on the method used.

    a) *Postage stamp test, Poten test, and Snap-Gauge test.* On the basis of Class III evidence, these tests may be viewed as promising inexpensive screening tests for psychogenic versus other causes of erectile dysfunction, with the appropriate caveats noted in the body of this report. These tests cannot be used alone in arriving at a final diagnosis in the patient complaining of impotence.

    b) *NPT testing.* This test is established in helping to distinguish psychogenic from other causes of impotence. The recommendation is based on Class III evidence.

    c) *Rigidometer.* This is promising as a home screening method in assessing both the presence and the quality of erections. The recommendation is based on Class III evidence.

4. *Intracorporeal injection of vasoactive agents.* This method may be considered an established diagnostic tool. These techniques are safe when performed by physicians who have the necessary skills and experience. These methods do have a recognized complication rate that has been generally accepted for most patients. This recommendation is based on Class II evidence.

5. *Electrodiagnostic methods* of evaluating penile and pudendal nerve conduction are safe. These tests (a, b, and c below) may be considered established methods of measuring what their names indicate, but they need to be correlated with other information in evaluating the impotent patient. They cannot in and of themselves detect impotence of neurogenic origin. With this in mind, they may be considered promising based on Class III evidence.
    a) Penile nerve conduction.
    b) Bulbocavernosus reflex responses.
    c) Pudendal somatosensory evoked responses.

6. *Penile biothesiometry.* This test is considered promising for the evaluation of penile sensation based on Class III evidence.

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Definitions

Safety. A judgment of the acceptability of risk in a specified situation, eg, for a given medical problem, by a provider with specified training, at a specified type of facility.

Effectiveness. Producing a desired effect under conditions of actual use.

Established. Accepted as appropriate by the practicing medical community for the given indication in the specified patient population.

Promising. Given current knowledge, this technology appears to be appropriate for the given indication in the specified patient population. As more experience and long-term follow-up are accumulated, this interim rating will change.

Investigational. Evidence insufficient to determine appropriateness; warrants further study. Use of this technology for given indication in the specified patient population should be confined largely to research protocols.

Doubtful. Given current knowledge, this technology appears to be inappropriate for the given indication in the specified patient population. As more experience and long-term follow-up are accumulated, this interim rating will change.

Unacceptable. Regarded by the practicing medical community as inappropriate for the given indication in the specified patient population.

Quality of evidence ratings

Class I. Evidence provided by one or more well-designed randomized controlled clinical trials.

Class II. Evidence provided by one or more well-designed clinical studies such as case-control studies, cohort studies, and so forth.

Class III. Evidence provided by expert opinion, nonrandomized historical controls, or one or more case reports.

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