Chapter 50
How do erections occur? How common is erectile dysfunction, what is its etiology, and how do you evaluate men with this problem?

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How do erections occur?

Penile erection requires an elaborate orchestration of neural, vascular, and hormonal processes in the proper psychological setting. Beginning with tactile stimulation of the penis or mental arousal, penile erection is a spinal reflex that is triggered by peripheral or central nervous stimuli. Erection is mainly mediated by parasympathetic nerve fibers located in the pelvic ganglion, which course via the cavernous nerve to the spongy vascular chambers of the penis, known as the corpora cavernosa.

Once a neural signal is transmitted, the process of tumescence begins with the filling of the corpora cavernosa with blood to create a rigid organ usable for sexual intercourse. Erections are initiated and maintained by two vascular processes: relaxation of the arteries of the corpora cavernosa to allow improved inflow of blood and increased resistance of outflow venous channels to maintain tumescence. The increased inflow is a complicated neurohormonal process, whereby messenger molecules, primarily nitric oxide, but also cGMP, cAMP, and others, are released by local neurons leading to smooth muscle relaxation, arterial dilation, and augmented blood flow. Increased resistance to outflow is a passive process wherein the venous channels are compressed against the tunica albuginea, the fibrous covering of the corpora cavernosa, by the expanding penile tissue.

Pelvic floor musculature is also key in the erectile response. The bulbospongiosus and ischiocavernosus muscles surround the corporal bodies at the base of the penis. These muscles contract in response to the bulbocavernous reflex during sexual arousal and help produce the rigid erection phase.

How common is erectile dysfunction?

Erectile dysfunction (ED) is defined as, "an impairment in the arousal phase of [the male] sexual response" with "consistent or recurrent inability to attain and/or maintain penile erection sufficient for sexual satisfaction, including satisfactory sexual performance." (AUA Guidelines, 2018).

The prevalence of ED has been reported by numerous sources, with approximately 20 percent of adult men classified as having ED. It is estimated that up to 150 million men globally have ED. Prevalence also increases with age. For men less than 40 years old, the worldwide rate of ED ranges from one to nine percent, but does appear to be increasing over time. For men in their sixties, rates vary from 20 to 40%. As much as 50 to 75% of men in their 70's and 80's will have ED. The development of ED has been associated with other medical conditions and risk factors, namely hypertension, diabetes mellitus, dyslipidemia, smoking, and cardiovascular disease.

What is its etiology?

Erectile dysfunction can manifest in a variety of ways and have many physiologic causes. Patients may be unable to achieve a complete erection, or to maintain an erection; they may have pain with erections or changes in erogenous penile sensation. These problems may be caused by dysfunctional neurons that carry messages to the penis, or there may be an inability of the blood vessels to deliver adequate blood flow to create and sustain an erection.

The causes of ED comprise five specific categories: (1) vasculogenic, due to either arterial or venous problems, (2) neurogenic, (3) endocrinologic, (4) medication-induced or (5) psychogenic.

The most common etiology of ED is by far vasculogenic, with venogenic (cavernosal) causes believed to be slightly more common than arteriogenic causes. Vasculogenic etiologies can be related to cardiovascular disease, like atherosclerosis, that leads to arterial insufficiency or degenerative changes of the fibroelastic tissue of the penis. Metabolic syndrome, a constellation of risk factors for heart disease, diabetes, and stroke, including hypertension, increased fasting glucose, central obesity, and dyslipidemia, has been identified as an increasingly common cause of ED.

Neurogenic causes are estimated to make up 10 to 19% of ED and may be related to neurological disease (like multiple sclerosis) or result from physical damage to nerves either during pelvic surgery or from traumatic injuries to the pelvis.

Endocrinologic causes of ED are rarer; however, thyroid hormone or sexual hormone abnormalities are more common in patients with ED than they are in the general population. While most men with ED do not have hypogonadism, studies have shown that once testosterone levels drop below a threshold of roughly 230 ng/dL, men can begin to experience ED. This may be due to the local effects of testosterone on penile tissue during erection.

Many cases of ED are medication-related. The most common culprits are anti-hypertensive medications, especially beta-blockers, that lower systemic blood pressure and lead to decreased blood perfusion to the penis for erection to occur. Other medications, such as many classes of psychiatric medications, can decrease libido or reduce levels of male sexual hormones (i.e. testosterone) and consequently lead to ED. Moreover, it is important to educate any man undergoing androgen deprivation therapy (ADT) that ED is a well-established potential side effect.

Psychogenic causes are believed to play a role to some extent in all cases of ED (often combined with another etiology). The most common psychogenic causes are depression, anxiety, and stress, although various psychiatric disorders can contribute to ED. Ultimately, mental health problems, emotional stressors, and inter-personal conflicts can have a negative impact on erectile function either primarily or secondarily.

Finally, many disease states that are related to ED can have more than one categorical etiology. For example, diabetes mellitus can contribute to both vasculogenic and neurogenic dysfunction, which can hinder the ability to achieve erection.

How do you evaluate men with this problem?

Shared decision making and an individualized approach to care are fundamental tenets for evaluating and treating ED. As such, all men presenting with symptoms of ED should undergo a comprehensive evaluation of medical, surgical, and psychosocial history, physical examination, medication reconciliation, and laboratory studies with additional specialized testing as indicated.

In eliciting details regarding the etiology of ED, it is important to understand if the ED is a problem of physical function (erections do not occur or are unsatisfactory) versus performance (erections can be achieved but not during sexual stimulation). The functional types can be thought of as organic ED versus psychogenic ED; organic ED refers to a physical aberration that prevents the achievement of a

functional erection, and is usually vasculogenic, neurogenic, endocrinologic in nature, or medication-related. In the absence of these conditions, psychogenic ED may be inferred. Etiologic and functional classifications of ED are demonstrated in Fig. 1.

Understanding the circumstances of the patient's ED can help delineate the type of ED and in some cases the etiology of ED. Important details of the sexual history specifically regarding erection include the degree of rigidity achieved, the presence of nocturnal or early-morning erections, the ability to have sexual intercourse or masturbate, and the presence of any deformities or curvatures of the penis.

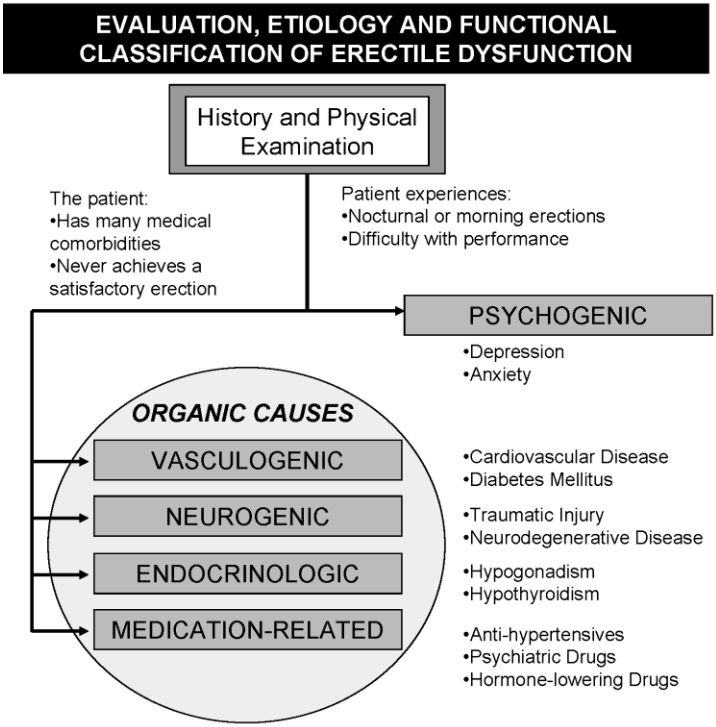

Figure 1. Evaluation, Etiology and Functional Classification of Erectile Dysfunction (ED). Common examples of disease states in each category are listed adjacent to each.

Questionnaires such as the Sexual Health Inventory for Men (SHIM), International Index of Erectile Function (IIEF), and Erection Hardness Score (EHS) are standardized tools used by physicians to understand and rate the severity of each patient's ED. In general, high scores indicate normal erectile function while lower scores indicate worsening degrees of ED. Additionally, discussing any psychological or interpersonal issues that may be contributing to the patient's ED symptoms is crucial to obtaining a thorough sexual history.

Many of these details can help the evaluating physician discern between organic and psychogenic types of ED. Once it is clear (or highly suspicious) that an organic type is responsible for ED, it is important to ascertain the patient's medical comorbidities, medical and surgical history, and medications. By investigating these details, physicians may find correctable causes of ED. For example, a patient whose ED coincides with starting metoprolol (a common anti-hypertensive medication) may warrant a trial of new medication to control his blood pressure.

Furthermore, it is extremely important to assess each patient's risk factors for cardiovascular disease. These risk factors include older age, hypertension, hyperlipidemia, diabetes mellitus, obesity, cigarette smoking, and a sedentary lifestyle. ED has come to be understood as an early indicator of possible cardiovascular or neurovascular disease, with some studies finding that diagnosis of moderate ED can precede presentation of serious systemic vascular disease by 2-3 years. Thus, determining the presence of these potentially modifiable factors can help patients not only improve their erectile function, but also decrease their risk of having a significant cardiovascular event (heart attack or stroke) in the future.

Physical examination should involve a careful inspection of the genitalia for deformities that may contribute to ED. Peyronie's Disease for example is a curvature of the penis that is associated with ED. A small or non-present testis or testes may be indicators of hypogonadism. In addition, a systematic vascular and neurological examination including palpation of peripheral pulses, abdominal exam for abdominal aortic aneurysm, inspection of the lower extremities for loss of hair growth, and neurologic exam for reflexes and neuropathy can help identify vasculogenic or neurogenic causes of ED.

In certain cases, additional laboratory and physiological tests may be helpful to define the cause or measure the severity of ED. For instance, serum lipid levels and hormone levels can help identify certain cardiovascular and endocrinologic etiologies of ED. In men

diagnosed with ED, it is recommended that morning serum testosterone levels be measured.

Further specialized testing is recommended only if it will influence ED management. Penile duplex ultrasound is the current gold-standard to determine whether or not there is adequate blood flow to the penis. Nocturnal penile tumescence and rigidity testing, office intracavernosal injection, and cavernosometry are other adjunctive tests that can aid in the evaluation of complex ED. Overall, many evaluations of ED are complete without the need for complicated testing – a detailed history and physical examination are often sufficient before initiating ED treatment.

Suggested reading

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