

# Erectile Dysfunction

## What is erectile dysfunction (ED)?

ED is the inability to get or keep an erection firm enough for sexual intercourse. ED can be a total inability to achieve an erection, an inconsistent ability to do so, or a tendency to sustain only brief erections.

ED is sometimes called impotence, but that word is being used less often so that it will not be confused with other, nonmedical meanings of the term.

The National Institutes of Health estimates that ED affects as many as 30 million men in the United States.<sup>1</sup> Incidence increases with age: About 4 percent of men in their 50s and nearly 17 percent of men in their 60s experience a total inability to achieve an erection. The incidence jumps to 47 percent for men older than 75.<sup>2</sup> But ED is not an inevitable part of aging. ED is treatable at any age.

<sup>1</sup>National Institutes of Health (NIH) Consensus Conference. NIH Consensus Development Panel on Impotence. Impotence. *Journal of the American Medical Association*. 1993;270:83-90.

<sup>2</sup>Saigal CS, Wessells H, Wilt T. Predictors and prevalence of erectile dysfunction in a racially diverse population. *Archives of Internal Medicine*. 2006;166:207-212.

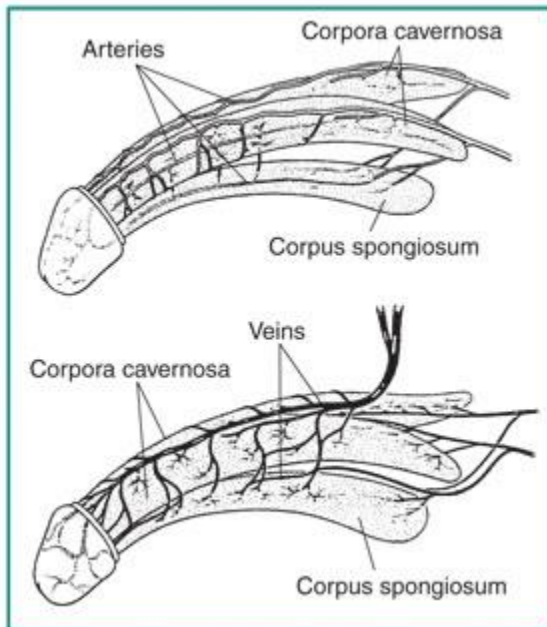
## How does an erection occur?

Two chambers called the corpora cavernosa run the length of the penis (see Figure 1). A spongy tissue fills the chambers. The corpora cavernosa are surrounded by a membrane, called the tunica albuginea. The spongy tissue contains smooth muscles, fibrous tissues, spaces, veins, and arteries. The urethra, which is the channel for urine and ejaculate, runs along the underside of the corpora cavernosa and is surrounded by the corpus spongiosum.

An erection begins with sensory or mental stimulation, or both. Impulses from the brain and local nerves cause the muscles of the corpora cavernosa to relax, allowing blood to flow in through the arteries and fill the spaces. The blood creates pressure in the corpora cavernosa, making the penis expand. The tunica albuginea helps trap the blood in the corpora cavernosa, thereby sustaining the erection. The erection ends when

muscles in the penis contract to stop the inflow of blood and open the veins for blood outflow.

**Figure 1. Arteries and veins of the penis**



Arteries (top) and veins (bottom) penetrate the corpora cavernosa and the corpus spongiosum. An erection occurs when relaxed muscles allow the corpora cavernosa to fill with excess blood fed by the arteries, while drainage of blood through the veins is blocked by the tunica albuginea.

## What causes ED?

ED usually has a physical cause, such as disease, injury, or side effects of drugs. Any disorder that causes injury to the nerves or impairs blood flow in the penis has the potential to cause ED.

Because an erection requires a precise sequence of events, ED can occur when any of the events is disrupted. The sequence includes nerve impulses in the brain, spinal column, and area around the penis, and response in muscles, fibrous tissues, veins, and arteries in and near the corpora cavernosa.

Damage to nerves, arteries, smooth muscles, and fibrous tissues, often as a result of disease, is the most common cause of ED. Diseases—such as diabetes, high blood pressure, nerve disease or nerve damage, multiple sclerosis, atherosclerosis, and heart

disease—account for the majority of ED cases. Patients should be thoroughly evaluated for these conditions before they begin any form of treatment for ED.

Lifestyle choices that contribute to heart disease and vascular problems also raise the risk of ED. Smoking, drinking alcohol excessively, being overweight, and not exercising are possible causes of ED.

Surgery—especially radical prostate and bladder surgery for cancer—can also injure nerves and arteries near the penis, causing ED. Injury to the penis, spinal cord, prostate, bladder, and pelvis can lead to ED by harming nerves, smooth muscles, arteries, and the fibrous tissues of the corpora cavernosa.

In addition, ED can be a side effect of many common medicines such as blood pressure drugs, antihistamines, antidepressants, tranquilizers, appetite suppressants, and cimetidine, an ulcer drug.

Psychological factors such as stress, anxiety, guilt, depression, low self-esteem, and fear of sexual failure can also cause ED. Even when ED has a physical cause, psychological factors may make the condition worse.

Hormonal abnormalities, such as low levels of testosterone, are a less frequent cause of ED.

## **How is ED diagnosed?**

### **Patient History**

A person's medical and sexual histories help define the degree and nature of ED. The medical history can disclose diseases that lead to ED, and a simple recounting of sexual activity might identify problems with sexual desire, erection, ejaculation, or orgasm.

Use of certain prescription or illegal drugs can suggest a chemical cause because drug effects are a frequent cause of ED.

### **Physical Examination**

A physical examination can give clues to systemic problems. For example, if the penis is not sensitive to physical touch, a problem in the nervous system may be the cause. Abnormal secondary sex characteristics, such as unusual hair pattern or breast enlargement, can point to hormonal problems, which would mean the endocrine system is involved. The doctor might discover a circulatory problem by observing decreased pulses in the wrist or ankles. And unusual characteristics of the penis itself could suggest the source of the problem—for example, a penis that bends or curves when erect could be the result of Peyronie's disease.

### **Laboratory Tests**

Several laboratory tests can help diagnose ED. Tests for systemic diseases include blood counts, urinalysis, lipid profile, and measurements of creatinine and liver enzymes. Measuring the amount of available testosterone in the blood can yield information about problems with the endocrine system and may explain why a patient has decreased sexual desire.

### **Other Tests**

Monitoring erections that occur during sleep—nocturnal erections—can help rule out certain psychological causes of ED. Healthy men have involuntary erections during sleep. If nocturnal erections do not occur, then ED is likely to have a physical rather than a psychological cause. Tests for nocturnal erections are not completely reliable, however. Scientists have not standardized such tests and have not determined when they should be conducted for best results.

### **Psychosocial Examination**

A psychosocial examination, using an interview and a questionnaire, can reveal psychological factors. A man's sexual partner may also be interviewed to determine expectations and perceptions during sexual intercourse.

## **How is ED treated?**

Most doctors suggest that treatments proceed from least to most invasive. Making a few healthy lifestyle changes may solve the problem. Quitting smoking, reducing alcohol

consumption, losing excess weight, and increasing physical activity may help some men regain sexual function.

Cutting back on or replacing medicines that could be causing ED is considered next. For example, if a patient thinks a particular blood pressure medicine is causing problems with erection, he should tell his doctor and ask whether he can try a different class of blood pressure medicine.

Psychotherapy and behavior modifications in selected patients are considered next if indicated, followed by oral or locally injected drugs, vacuum devices, and surgically implanted devices. In rare cases, surgery involving veins or arteries may be considered.

## **Psychotherapy**

Experts often treat psychologically based ED using techniques that decrease the anxiety associated with intercourse. The patient's partner can help with the techniques, which include gradual development of intimacy and stimulation. Such techniques also can help relieve anxiety during treatment for ED from physical causes.

## **Drug Therapy**

Drugs for treating ED can be taken orally, injected directly into the penis, or inserted into the urethra at the tip of the penis.

### **Oral Medications**

In March 1998, the U.S. Food and Drug Administration (FDA) approved sildenafil (Viagra), the first pill to treat ED. Since that time, vardenafil hydrochloride (Levitra) and tadalafil (Cialis) have also been approved. Additional oral medicines are being tested for safety and effectiveness.

Viagra, Levitra, and Cialis all belong to a class of drugs called phosphodiesterase (PDE) inhibitors. Taken an hour before sexual activity, these drugs work by enhancing the effects of nitric oxide, a chemical that relaxes smooth muscles in the penis during sexual stimulation and allows increased blood flow.

The recommended dose for Viagra is 50 milligrams (mg), and the doctor may adjust this dose to 100 mg or 25 mg, depending on the patient. The recommended dose for either Levitra or Cialis is 10 mg, and the doctor may adjust this dose to 20 mg if 10 mg is

insufficient. Lower doses of 5 mg and 2.5 mg are available for patients who take other medicines or have conditions that may decrease the body's ability to use the drug. The 5 mg and 2.5 mg doses of Cialis are FDA-approved for daily use.

None of these PDE inhibitors should be used more than once a day. Men who take nitrate-based drugs such as nitroglycerin pills for heart problems should not use any of the three drugs because the combination can cause a sudden drop in blood pressure. Also, men should tell their doctor if they take any drugs called alpha-blockers, which are used to treat prostate enlargement or high blood pressure. The doctor may need to adjust the ED prescription. Taking a PDE inhibitor and an alpha-blocker within 4 hours of each other can cause a sudden drop in blood pressure. A small number of men have experienced vision or hearing loss after taking a PDE inhibitor. Men who experience vision or hearing loss should seek prompt medical attention.

Oral testosterone can reduce ED in some men with low levels of natural testosterone, but it is often ineffective and may cause liver damage. Patients also have claimed that other oral drugs—including yohimbine hydrochloride, dopamine and serotonin agonists, and trazodone—are effective, but the results of scientific studies to substantiate these claims have been inconsistent. Improvements observed following use of these drugs may be examples of the placebo effect—that is, a change that results simply from the patient's belief that an improvement will occur.

### **Injectable Medications**

While oral medicines improve the response to sexual stimulation, they do not trigger an automatic erection as injections do. Many men achieve stronger erections by injecting drugs into the penis, causing it to become engorged with blood. Drugs such as papaverine hydrochloride, phentolamine, and alprostadil widen blood vessels. The injectable form of alprostadil is marketed as Caverject. These drugs may create unwanted side effects, however, including scarring of the penis and persistent erection, known as priapism. Nitroglycerin ointment, a muscle relaxant, can sometimes enhance an erection when rubbed on the penis.

A system for inserting a pellet of alprostadil into the urethra uses a prefilled applicator to deliver the pellet about an inch into the urethra. The pellet form of alprostadil is marketed as MUSE. An erection will begin within 8 to 10 minutes and may last 30 to 60 minutes. The most common side effects are aching in the penis, testicles, and area

between the penis and rectum; a warm or burning sensation in the urethra; redness from increased blood flow to the penis; and minor urethral bleeding or spotting.

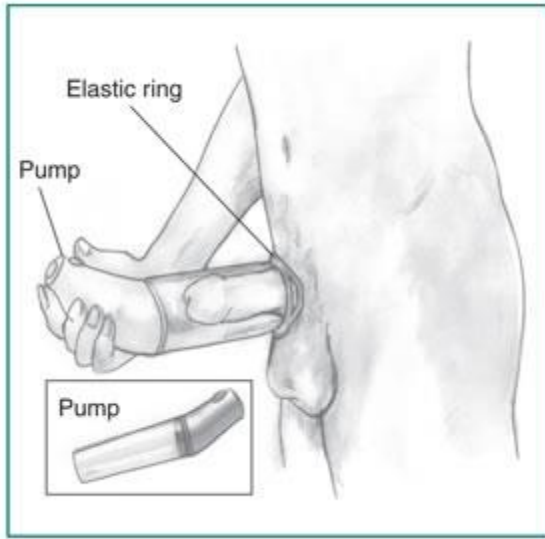
Research on drugs for treating ED is expanding rapidly. Patients should ask their doctor about the latest advances.

### **Vacuum Devices**

Mechanical vacuum devices cause an erection by creating a partial vacuum, which draws blood into the corpora cavernosa, engorging and expanding the penis. The devices have three components: a plastic cylinder, into which the penis is placed; a pump, which draws air out of the cylinder; and an elastic ring, which is moved from the end of the cylinder to the base of the penis as the cylinder is removed. The elastic ring maintains the erection during intercourse by preventing blood from flowing back into the body (see Figure 2). The elastic ring can remain in place up to 30 minutes. The ring should be removed after that time to restore normal circulation and to avoid skin irritation.

Couples may find that using a vacuum device requires some practice or adjustment. An erection achieved with a vacuum device may not feel like an erection achieved naturally. The penis may feel cold or numb and have a purple color. Bruising on the shaft of the penis may occur, but the bruises are usually painless and disappear in a few days. Ejaculation may be weakened because the elastic ring blocks some of the semen from traveling through the urethra, but the pleasure of orgasm is usually not affected.

**Figure 2. Vacuum device**



A vacuum device causes an erection by creating a partial vacuum around the penis, which draws blood into the corpora cavernosa.

## **Surgery**

Surgery usually has one of three goals:

- to implant a device that can cause the penis to become erect
- to reconstruct arteries to increase blood flow to the penis
- to block off veins that allow blood to leak from the penile tissues

Implanted devices, known as prostheses, can restore erection in many men with ED.

Malleable implants usually consist of paired rods, which are inserted surgically into the corpora cavernosa. The user manually adjusts the position of the penis and, therefore, the rods. Adjustment does not affect the width or length of the penis.

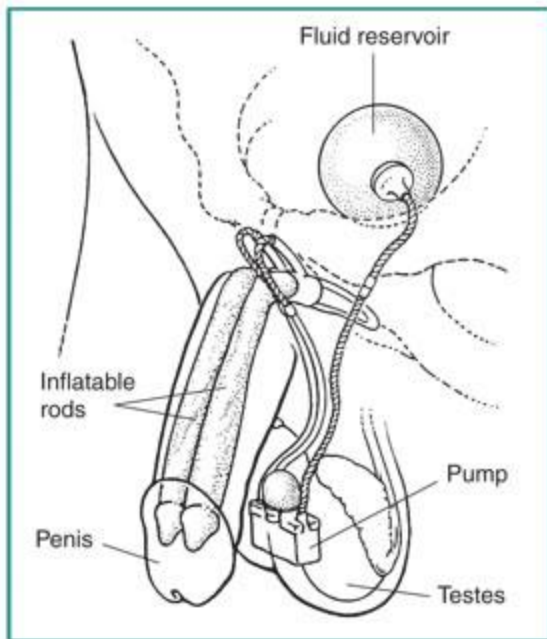
Inflatable implants consist of paired cylinders, which are surgically inserted inside the penis and can be expanded using pressurized fluid (see Figure 3). Tubes connect the cylinders to a fluid reservoir and a pump, which are also surgically implanted. The patient inflates the cylinders by pressing on the small pump, located under the skin in the scrotum. The pump causes fluid to flow from a reservoir residing in the lower pelvis to two cylinders residing in the penis. Inflatable implants can expand the length and



width of the penis to some degree. They also leave the penis in a more natural state than malleable implants do when not inflated.

Once a man has either a malleable or inflatable implant, he must use the device to have an erection. Possible problems with implants include mechanical breakdown and infection, although mechanical problems have decreased in recent years because of technological advances.

**Figure 3. Surgical implant**



With an inflatable implant, an erection is produced by squeezing a small pump implanted in the scrotum. The cylinders expand to create the erection.

Surgery to repair arteries can reduce ED caused by obstructions that block the flow of blood. The best candidates for such surgery are young men with discrete blockage of an artery because of an injury to the groin or fracture of the pelvis. The procedure is usually unsuccessful in older men with widespread blockage.

Surgery to veins that allow blood to leave the penis usually involves an opposite procedure—intentional blockage. Blocking off veins, called ligation, can reduce the leakage of blood that diminishes the rigidity of the penis during an erection. However, experts have raised questions about the long-term effectiveness of this procedure, and it is rarely done.

## Points to Remember

- Erectile dysfunction (ED) is the inability to get or keep an erection firm enough for sexual intercourse.
- ED affects as many as 30 million American men.
- ED is usually associated with a medical condition such as diabetes, high blood pressure, nerve disease or nerve damage, multiple sclerosis, atherosclerosis, and heart disease. Patients should be thoroughly evaluated for these conditions before they begin any form of treatment for ED.
- Lifestyle choices that contribute to heart disease and vascular problems also raise the risk of ED. Smoking, drinking alcohol excessively, being overweight, and not exercising are possible causes of ED.
- ED is treatable at all ages.
- Treatments include lifestyle and medication changes, psychotherapy, drug therapy, vacuum devices, and surgery.

## Hope through Research

Advances in suppositories, injectable medications, implants, and vacuum devices have expanded the options for men seeking treatment for ED. These advances have also helped increase the number of men seeking treatment. Gene therapy for ED is now being tested in several centers and may offer a long-lasting therapeutic approach for ED.

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) sponsors programs aimed at understanding and treating ED. The NIDDK's Division of Kidney, Urologic, and Hematologic Diseases supported the researchers who developed Viagra and continue to support basic research into the mechanisms of an erection and the diseases that impair normal function at the cellular and molecular levels, including diabetes and high blood pressure.

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For information about current studies, visit [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov).

## For More Information

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