Managing Erectile Dysfunction – A Patient Guide

Peter R. Carroll MD, MPH, Tom F. Lue MD, Stan Rosenfeld, James F. Smith MD and Alan W. Shindel, MD,
Department of Urology UCSF Comprehensive Cancer Center
University of California, San Francisco

Greetings!

These guidelines are designed to provide men with Erectile Dysfunction (ED) and their partners information and advice on the condition. We hope that this information will give you confidence about addressing any erectile problems you may experience, no matter the cause. For some people, this information will be completely new. Others may be well informed about ED and its treatment options, and much of what is discussed herein may be familiar. Either way, don't feel that this material has to be fully absorbed in one sitting. Reviewing the information presented here with your physician or nurse practitioner may make it more specific to your needs. We would be grateful if you could fill out the questionnaire at the end of the booklet and return it to us with your feedback. This will help us ensure that future editions of this booklet address your questions and concerns.

If you would like to discuss the various treatment options, UCSF has medical professionals and patients available to speak with you. To talk with a medical professional, contact the UCSF Center for Reproductive Health at (415) 353-3075. To receive the contact information for a patient who has had an erection problem and tried available aids, contact the UCSF Helen Diller Family Comprehensive Cancer Center's Resource Center at 415.885.7210

Table of Contents

2 Introduction
2 What is ED?
3 ED and Cancer Surgery or Radiation
4 Treatment of ED
14 Causes of ED
17 Mechanisms of Penile Erection
18 Future Directions
18 Additional Resources

SDURO0095 • Revised 3/18

Introduction

ED is a relatively common problem, affecting up to 30 million men of all ages in the United States, and over 150 million men worldwide. The ability to have an erection requires complex coordination of nerves, blood vessels, muscles, and the brain. ED may result from psychological, neurological, hormonal or vascular impairment, or any combinations of these factors. Our goals with this Patient Guide are to explain how penile erection is achieved, what conditions may cause ED, and how to effectively manage the condition.

What is ED

Normal male sexual function is often thought of as a linear process: sexual interest or desire is the first phase which often leads to penile erection, during which the penis becomes firm by filling with blood. After a period of sexual excitement/activity most men experience ejaculation (release of semen from the penis) which is accompanied by orgasm, a sensation of intense pleasure and/or contentment. It is important to note that orgasm and ejaculation are separate processes that may occur independently. It is also possible to experience ejaculation and/or orgasm in the absence of penile erection.

Decreased sexual desire or libido is common and may occur in the setting of psychological distress (depression/anxiety), stress, and relationship conflict. Some health problems are associated with decreased desire. Decreased sexual desire has also been associated with low blood levels of testosterone, the “male hormone.”

Erectile dysfunction – commonly known as ED – is defined as the inability to achieve or maintain an erection that is sufficient for satisfactory sexual activity. Ejaculation, the release of semen during sexual activity, relies on coordinated action of the muscles of the lower urinary tract and prostate. The prostate and the seminal vesicles produce most seminal fluid. Medications, surgeries, and radiation treatments for prostate problems often cause changes in ejaculation. Ejaculation changes are also common with increasing age.

Orgasm occurs as an experience of intense physical and emotional pleasure at the climax of sexual activity. Our current scientific understanding of the experience of orgasm is limited. Many factors, including emotional, psychological, and health considerations, contribute to the experience of orgasm. Changes in ejaculation may also influence a man’s perceptions of orgasm. Some men may also experience ejaculation but have a mild or even no sensation or orgasm.

It is important to realize that male sexual function is not simply the ability to have a rigid erection and/or an ejaculation. A careful assessment of sexual life and the quality of a man’s sexual relationship are important to produce the best outcomes when addressing sexual problems. Mutually satisfactory sexual relationships can be maintained in the presence of ED or other sexual problems. For more information about this, refer to the books listed at the end of this guide.

ED is common with age and in the presence of other medical conditions

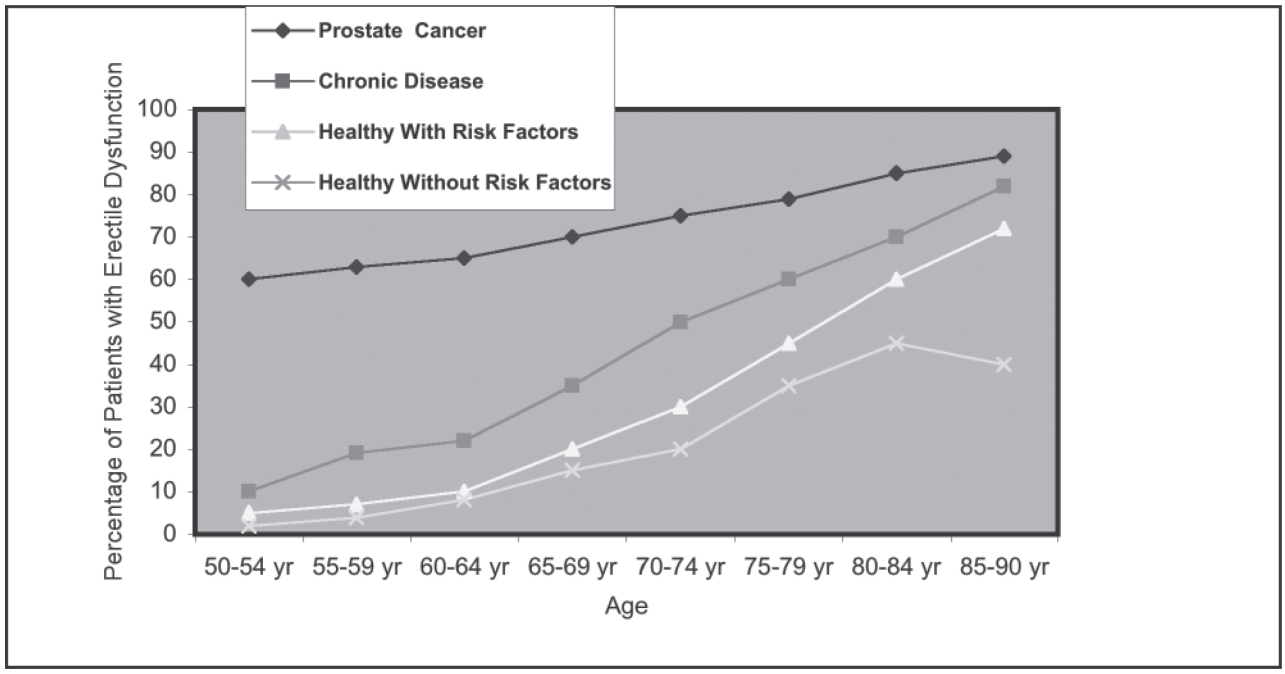

Figure 1: Prevalence of Erectile Dysfunction with Age in Different Patient Populations.

Chronic disease includes other cancer, hypertension, cardiac disease, diabetes or stroke.

Risk factors include antidepressant use, consumption of more than two alcoholic drinks per day, smoking, obesity, lack of exercise and watching television for more than 8.5 hours per week.

Data from Ann Intern Med. 2003 Aug 5; 139(3): 161-8. Printed with Permission from the American College of Physicians

ED and Cancer Surgery or Radiation

ED is very common after major pelvic surgery or radiation, including treatments for prostate or bladder diseases. The nerves that drive erection, called cavernous nerve bundles, are located immediately next to the prostate gland. During a radical prostatectomy (RP, an operation for prostate cancer) these nerves may be injured by being cut or separated from the prostate. This may cause temporary or permanent ED. Because the prostate makes most of the fluid in semen, men who have had RP do not experience ejaculation. Radiation to the prostate, the bladder or rectum can also damage the cavernous nerves and lead to problems with erections and ejaculation. Although ED and absence of ejaculation are common after RP or prostate radiation, sexual desire and the ability to achieve orgasm are still possible.

A “nerve-sparing” RP or radical cysto-prostatectomy (RC, an operation for bladder cancer) is a procedure designed to remove cancer while preserving the cavernous nerve bundles. The theoretical advantage is that erectile function may be at least partially preserved. In the hands of an experienced surgeon and if both nerve bundles are spared, 50 to 90 percent of patients have a return of at least some erectile function over 2 years post-surgery. When only one nerve bundle is spared, the percentage of patients that have return of erections over 2 years is closer 25 to 50 percent. If a non-nerve sparing technique is necessary, the proportion of patients able to achieve erections without using one of the several available aids, is about 16 percent or less. Nerve sparing surgery offers a number of advantages in terms of erectile function. However, in some cases the patient’s tumor may make nerve sparing approaches inadvisable. Patients with large and/or high grade tumors may not be candidates for nerve sparing surgery.

Nerve sparing surgery is superior to non-nerve sparing surgery in terms of preserving erectile function. However, a number of other factors are also important. Patients with medical problems (e.g. high blood pressure, high cholesterol, diabetes, tobacco use), men who have ED prior to surgery/radiation, and older men are more likely to have difficulty obtaining a rigid erection after surgery/radiation. Most men under the age of 50 treated for prostate cancer recover erectile function; only about 20% of men over the age of 70 have return of erections without medical therapy. Depression, psychological stress, and relationship conflict may also make recovery more difficult by affecting both sexual desire and penile erection.

Even in nerve sparing surgery there is typically some trauma to the cavernous nerves during RP/RC based on their closeness to the prostate (See Figure 2). Men should expect several months of difficulty attaining natural erections even after nerve sparing operations. The process of recovery may take up to 2 or 3 years.

For men undergoing radiation, the amount and extent of radiation as well as whether or not they are treated with hormone therapy correlates with the likelihood of ED, either temporary or permanent. Men may not experience immediate ED while under treatment with radiation but over time ED symptoms become more prevalent after radiation treatment. Reductions in libido and difficulties with erections may also result from the use of hormone therapy; this is generally reversible when the therapy is discontinued. The likelihood of irreversible effects is related to patient age, pre-treatment sexual function and the length of time hormone therapy is given.

Penile rehabilitation is a strategy for optimizing erectile function outcomes after treatment of prostate or bladder cancer with surgery and/or radiation. This approach is based on the theory that lack of blood flow and erections after cancer treatment will lead to scarring and shrinkage of the penis; thus, even if the nerves recover over time changes to the penis itself may make erections difficult. Theoretically, if blood flow to the penis can be maintained the tissue may be less prone to scarring and shrinkage.

The most common form of penile rehabilitation involves use of oral medications and/or devices to help stimulate blood flow and erection. The evidence is mixed on how well these interventions work but there is little risk of harm from using treatments to help erections after surgery. Staying engaged in a program of rehabilitation can help men stay committed to recovery of their sexual quality of life, and use of the medications can help to facilitate sexual activity during the recovery process. Attention to vascular health (e.g. exercising, eating a sensible diet) and maintaining intimacy with one's sexual partner is also a critical component of penile rehabilitation.

Treatment of ED

The type of treatment will depend on the reason(s) for ED, patient age, health and patient and physician preference. Most often, a step-wise approach will be taken with the least intrusive option selected first. There are a number of medical options that can help men attain and maintain a rigid penis for sexual activity. While a step-wise approach from simple to more complicated treatments is appropriate for most patients some patients may choose to "skip" or avoid some of the available treatment options. In the end, the goal is always to re-establish sexual intimacy and pleasure, which can be achieved in a number of ways. Each individual man needs to decide on which priorities and what treatments are acceptable for him.

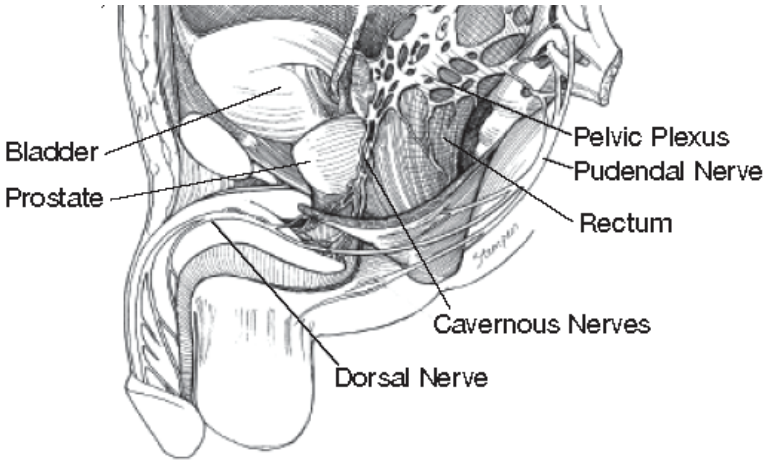

Figure 2: Nerves of the Pelvis. Note the close relationship of the prostate to the cavernous nerves (nerves that allow erection)

Coping with Erectile Dysfunction

Treatments for ED are very effective but don't work in every case. Some men may also choose to avoid certain treatments due to being too bothersome.

For men in whom acceptable treatments for ED don't work, options remain for sexual intimacy & pleasure. Men who are unable to achieve a rigid erection may still enjoy cuddling, genital caressing, and/or oral sex. With a supportive partner, patience, and a willingness to explore different means of being sexual, most men are able to achieve sexual satisfaction and even orgasm, regardless of whether they can obtain an erection sufficient for penetrative sex.

A good way to resume your sex life is to use a gradual, progressive approach and to make sure that you and your partner feel comfortable at every step. Sensual, mutually pleasuring activities with no performance goal can allow you to be intimate in a relaxed way.

A man and his partner may need to redefine what is important about their sexual relationship after cancer treatment. Although some may see kissing, caressing, and/or oral sex as simply foreplay in preparation for intercourse, arousing each other and even reaching orgasm without intercourse can be an important component of intimacy and a common way to share physical pleasure and emotional closeness without the need for a rigid erection. Your sex life should be based on what you and your partner mutually define as sexually satisfying and pleasurable; this may or may not include penile penetration. Vibrators have been used effectively by both men and women to achieve orgasm.

Men often overestimate the important their partners place on penetration. Certainly it is an important part of sexual life for many couples and there are a number of medical options to help men achieve a rigid erection for penetration. However, in situations where a man cannot achieve or maintain an erection it is important to focus on mutual pleasure and intimacy, not erectile hardness.

If you would like access to sexual or marriage counseling/advice, please ask your physician for a referral.

The American Association of Sex Educators, Counselors, and Therapists also maintains a website that contains valuable information on sexual wellness (www.aasect.org).

Table I: Treatment for ED

Type of Therapy	Advantages	Disadvantages
Oral Medication (Viagra®, Levitra®, Cialis®, Stendra®)	• Pills taken by mouth • Effective in many men	• Not always effective in patients who have prostatectomy, particularly when a non nerve-sparing approach is used • May take 30-120 minutes for full effect • Requires sexual stimulation to be effective • Potential side effects include headache, flushing, stomach upset, muscle pain • Cannot be taken with some medications, especially any sort of nitrate medication for heart problems
Medicated-Urethral Suppository for Erections (MUSE™)	• Small pellet placed in the urethra • Few systemic side effects	• Can cause pain and/or burning sensation • Requires training • Refrigeration required • Side effects include (rarely) painful and prolonged erection of more than six hours, fainting, dizziness, pain or burning for the sexual partner
Penile Injections	• Highly effective • Few systemic side effects • Works in three to five minutes	• Some medications require refrigeration • Requires injection into the penis • Requires office training • Can cause penile pain • Can cause prolonged erection • Theoretical risk of penile scaring
Vacuum Device	• No systemic side effects • Potentially low cost	• Can cause numbness or bruising • Erection sometimes described as “less natural” • requires the use of a tight ring at the base of the penis • Some men find the device awkward to use
Penile Prosthesis	• Highly effective • Can be activated and deactivated in seconds	• Requires anesthesia and surgery • Small risk of infection which requires removal • Mechanical device which may break and require replacement

Oral Medications

Four oral medications are commonly given for the treatment of ED: sildenafil (Viagra®), tadalafil (Cialis®) vardenafil (Levitra®), and avanafil (Stendra®). These medications improve erections by working locally on the penis by inhibiting an enzyme called phosphodiesterase-5 (PDE-5). Following sexual stimulation, a compound called nitric oxide is released at the nerve terminals causing relaxation of penile smooth muscles. This occurs via a sequence of events beginning with nitric oxide, and involving a compound cyclic guanine monophosphate (cGMP). cGMP helps blood vessels to stay open and maintains penile blood flow to keep an erection strong. PDE-5 breaks down cGMP and returns the penis to a flaccid state. All four of the ED medications currently available work by blocking the action of PDE-5, causing an increase in the level of cGMP levels in the penis. In the absence of sexual stimulation or in cases where there has been injury to the cavernous nerves, nitric oxide production may be minimal and these medications will have little effect on the penis. These oral agents must be followed by sexual stimulation in order to achieve the desired erection.

Compared to men taking a “placebo” of an inactive or sugar pill, men taking PDE-5 inhibitors report a higher satisfaction rate in overall sexual function, orgasm, penile rigidity and maintenance of erections. A patient’s response to these medications may reach from 70 to 80 percent, depending on patient age, health, etc.

Oral medications have been used as a form of penile rehabilitation for men who have undergone radical prostatectomy, radiation therapy, and hormone therapy, with the theory being that enhanced blood flow may help to spur recovery of spontaneous erections by keeping the penile tissues supplied with blood. Data are conflicting on how well this approach works but there appears to be little harm from routine use of oral treatments for ED after prostate cancer surgery. Aside from potential long term benefits, enhancement of erectile response from use of these medications may help to facilitate sexual encounters and maintain intimacy while a man is in recovery from prostate cancer treatment.

Viagra and Levitra remain in the blood stream and can help men achieve erections for about 6–8 hours. Cialis is a long acting medication which may exert an effect over 36 hours. Stendra stays in the circulation for a period of time somewhere between the Cialis and the other drugs. Studies show that all four drugs are well tolerated with few side effects.

Men at risk for heart attack or stroke should consult with their physicians before engaging in sexual activity as this can be a strain on the heart. Men who are taking nitrate medicines should not take any of these medications as the combination can cause a severe drop in blood pressure that could be life threatening. Caution should also be exercised in men who are taking alpha blocker medications (commonly used for prostate problems and/or for high blood pressure).

Table II: Oral Medications

How to take Oral Medications (Viagra/Levitra/ Cialis)	• Take 50 mg of Viagra one hour before you are ready to engage in sexual activity • Viagra works best 30 minutes to four hours after taking the pill • Viagra works best on an empty stomach. Do not take Viagra after a high-fat meal
Viagra	• If you do not achieve an erection with stimulation, you can increase the dosage of medications used the next time sexual activity is planned. After surgery, most men require doses of 100mg of Viagra
Levitra	• Take 10 mg of Levitra one hour before you are ready to engage in sexual activity • Levitra works best 30 minutes to four hours after taking the pill • If you do not achieve an erection, you may need to increase the dosage to 20 mg. After surgery, most men require doses of 20 mg of Levitra
Cialis	• Take 10 mg of Cialis up to 36 hours before you are ready to engage in sexual activity • Cialis can be taken after meals • If you do not achieve an erection on 10 mg, increase the dosage to 20 mg. After surgery, most men require doses of 20 mg of Cialis
Standra	• Take 100 mg of Stendra one half hour before you are ready to engage in sexual activity • Stendra works best 30 minutes to four hours after taking the pill • If you do not achieve an erection, you may need to increase the dosage to 200 mg. After surgery, most men require doses of 200 mg of Stendra
Side effects for all oral medications listed above	• Most common side effects include headache, facial flushing and upset stomach • A small number of patients taking Viagra or Levitra may complain of a “blue cast” to their vision, sensitivity to light or blurred vision • Back pain and joint aches may occur with Cialis
Things to remember for all oral medications listed above	• Do not use Viagra, Cialis, Levitra, or Stendra more than once per day • Do not use Viagra, Cialis, Levitra, or Stendra if you take medications such as nitroglycerin, Nitrostat, Nitro-Bid, Nitro-Dur, Isordil and Ismo, or Deponit • Talk to your doctor if you are taking Flomax, Hytrin, Cardura, Rapaflo, or Uroxatral; using these medications in combination may rarely lead to significant drops in blood pressure

Penile Rehabilitation

Many experts have suggested that maximizing blood flow to the penis after nerve-sparing radical prostatectomy can improve erectile function and decrease the likelihood of needing long-term treatment for ED after surgery. This is typically accomplished by administering regular doses of medications like Viagra, Levitra, Stendra, or Cialis without necessarily planning to have sex; in some cases physical exercises and/or a vacuum erection device may also be used. It is important to recognize while some studies have shown that ED pills and injection therapy can help men recover unassisted erection function faster after surgery, not all have. The decision of whether or not to take medications as part of penile rehabilitation should be made taking into consideration some of the controversies and also the cost of medication over time.

Regardless of their use in rehabilitation, erection medications can be very helpful in helping men achieve erection after prostate cancer treatment. We also encourage men to maintain intimacy with their sexual partner during the recovery process; the emotional rehabilitation and maintenance is as important as the physical recovery.

There are numerous protocols for "penile rehabilitation." One UCSF protocol is detailed below:

Table III Penile Rehabilitation

Two weeks prior to prostatectomy	• 100mg Viagra or 20 mg Levitra 2x/week and 50mg Viagra or 10mg Levitra on days not taking 100mg Viagra/20 mg Levitra dose
After catheter removal	• Viagra 50mg or Levitra 10 mg daily or Cialis 10mg 3x/week. Take in the evening to enhance nocturnal erections. Take Viagra 100mg, Levitra 20mg, or Cialis 20 mg at least weekly with sexual stimulation
Evaluation of sexual function 8-12 weeks after surgery	• If you have a response to oral medications (penile fullness or erection), continue Viagra 50mg or Levitra 10 mg daily 4–5 days/ week and 100mg Viagra or 20 mg Levitra 2–3x per week. Alternatively, use Cialis 20mg 3x/week • If no or marginal response to oral medications, begin penile injections and/or vacuum erection instruction. Consider beginning injections 2–3 times per week or vacuum erection use 2–3 times per week. Continue 50mg Viagra or 10 mg Levitra 10mg 4–5 days per week on days when not using injections
Evaluation of sexual function 12 months after surgery	• If no spontaneous erections after 1 year and unsatisfied with penile injections or vacuum erection device, consider alternative interventions for erectile dysfunction. For men with acquired penile curvature (Peyronie's disease) or complex sexual concerns earlier intervention may be warranted

NOTE: These recommendations are typical and may vary from what your physician may be prescribing. Please speak to your physician before beginning or changing any treatment.

Data from: Padma-Nathan H, McCullough AR, Levine LA, et al.: Randomized, double-blind, placebo-controlled study of postoperative nightly sildenafil citrate for the prevention of erectile dysfunction after bilateral nerve-sparing radical prostatectomy. Int J Impot Res 2008, 20:479–486.

Montorsi F, Brock G, Lee J, et al.: Effect of nightly versus on-demand vardenafil on recovery of erectile function in men following bilateral nerve-sparing radical prostatectomy. Eur Urol 2008, 54:924–931.

Mulhall JP. The role and structure of a postradical prostatectomy penile rehabilitation program. Curr Urol Rep. 2009 May;10(3):219-25.

Urethral Suppository - MUSE

The medicated urethral system for erection (MUSE) system consists of a pellet of a medication called Prostaglandin E1 (Alprostadil™) which is placed inside the penile urethra. MUSE may be used when oral pills are not an option or have failed. Large studies from Europe and the United States demonstrated that MUSE was effective in 43 percent of men with ED from various causes. The major advantage of MUSE therapy is that it is applied locally and has few systemic side effects. However, MUSE may cause significant penile pain and may be transferred to a partner, leading to pain or discomfort for them during sex. Rarely, MUSE may also lead to bleeding, dizziness, or decreased blood pressure.

In cases where MUSE is effective but painful, some men may benefit by applying a small dose of lidocaine jelly to the urethra before placing the pellet. Patients who are interested in MUSE should have the treatment administered in the office to ensure that they have proper technique and to monitor for response. Patients interested in MUSE therapy should be instructed on proper technique in their physician's office; a test dose may be applied in this setting so that side effects can be monitored.

Table IV: MUSE Therapy

How to Use MUSE Therapy	• Patients/partners should be trained in the office • Pellet of medication is inserted into urethral opening • Medication is absorbed to produce erection
Possible Side Effects	• Penile pain • Can rarely cause priapism – a prolonged erection greater than six hours • Fainting, dizziness, low blood pressure
Things to Remember	• After placement, stimulation is required to increase blood flow to the penis • Medication should be refrigerated • Maximum use is limited to one suppository per day

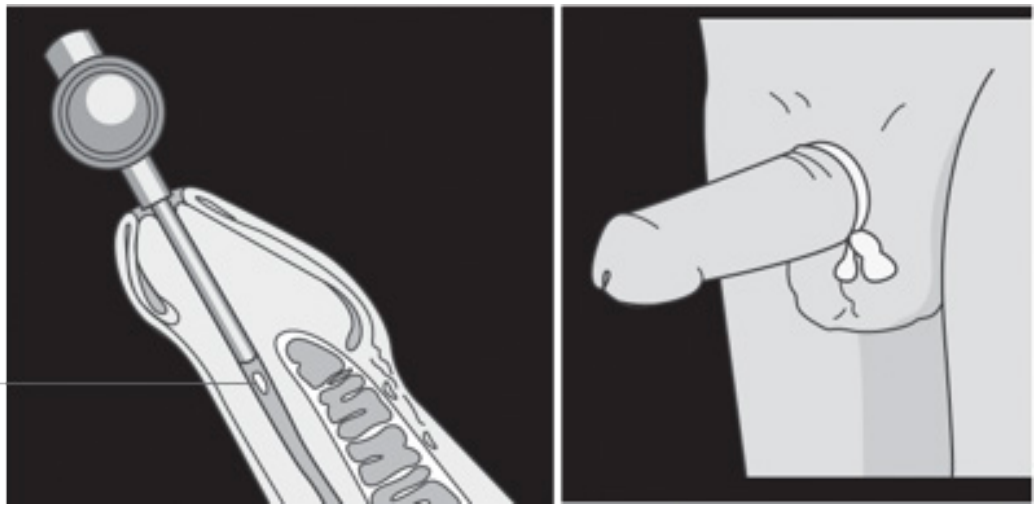

Figure 3: Application of intra-urethral suppository and constriction device. Application for intra-urethral delivery of Alprostadil. Depressing the end releases the pellet into the urethra. In some cases application of a constriction ring may enhance penile response

Penile Injection

When oral medication fails, penile injections to induce erection are another alternative to treat ED. While many men object to the notion of an injection into the penis, the needle typically used for these injections is smaller than a human hair and oftentimes not even painful. The most commonly used agents include prostaglandin E1 or a combination of different drugs that cause increased blood flow (e.g. papaverine, phentolamine). Combinations of different medicines may be more effective than single drugs alone and may also carry lower risks for side effects.

Men must have appropriate training and education before beginning penile injection therapy. The goal of the injection medication is to achieve an erection that is sustained for sexual intercourse, but not prolonged or painful. The injections must be given in proper amounts with the appropriate technique to minimize the risk of scarring in the penis or priapism, a prolonged and painful erection which may cause permanent damage.

The medication is injected into the side of the penis into the corpora cavernosa, the paired erectile bodies of the penile shaft. After choosing the proper site to inject, the skin should be cleaned with an alcohol pad. The needle is inserted perpendicular to the penile shaft so as to enter the right spot; it is important that the medicine be administered to the inside of the corporal body, not just underneath the skin. After the medication is injected, the needle is withdrawn and firm pressure is applied to the site to reduce the risk of bleeding or bruising; men who take aspirin or other blood thinner should hold pressure for a bit longer. Some experts recommend that men stand for at least 10 minutes after injection to enhance penile blood flow. Penile stimulation may also help enhance response.

Men who are interested in injections but unable to administer the shot themselves may enlist the aid of their partner. Alternatively, an auto-injector is a spring-loaded device that inserts the needle into the penis very quickly, minimizing psychological “hesitancy.” A variety of injectors are available; talk to your doctor if you think that an auto-injector might help you.

Improper injection and any subsequent scarring can lead to penile curvature and nodules in the penis, so it is important to get the proper training before beginning injection therapy. Most men and their partners find that injection therapy is easy to perform and are very pleased with the results.

Some patients who have been treated for prostate or bladder cancer may benefit from using injection therapy early on after surgery; as their erectile function gradually recovers such men may wish to then switch to oral agents.

Table V: Penile Injections

How to Perform Penile Injection	• Patients should be trained in the office • Generally performed with insulin syringe and small needle • Skin and injection site prepared with alcohol swab • Medication is drawn up in sterile manner with insulin syringe • Medication is injected on one side of the penis • Pressure is held on injection site for several minutes • For more detail on just where and how to inject and other information on injection therapy, see Successful Self Penile Injection Hints, Questions and Answers found on the prostate cancer page of our website urology.ucsf.edu
Side Effects	• Occasionally associated with fainting, dizziness, low blood pressure • Priapism or prolonged erection (greater than 4 hours) may occur • Can cause pain, infection, bruising and scarring if patients are not trained properly
Things to Remember	• May require self-stimulation to increase blood flow to the penis • If erection persists for more than four hours, seek medical care at local emergency room or with your urologist • May be ineffective if patients have vascular disease or blood flow problems

Figure 4: Intra-cavernous injection therapy. After cleaning with an alcohol swab, insert needle into side of penis and inject medication.

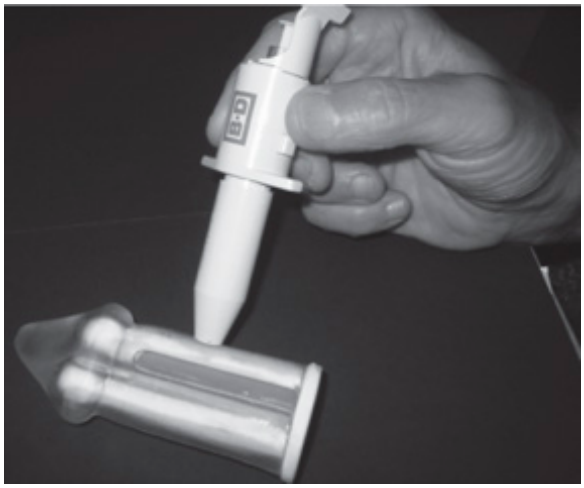

Figure 5: Auto-injection technique. The medication is drawn into the auto-injector. The side of the penis is cleaned with an alcohol swab and the injector placed against the penis. Pressing a button then activates the injector and the needle is automatically inserted.

Vacuum Erection Device

In patients who only have partial erections or who either do not respond to other treatments or prefer not to use them, a vacuum erection device maybe helpful. The device consists of a plastic cylinder connected to a pump and a constriction ring. A vacuum pump uses either manual or battery power to create suction around the penis and bring blood into it; a constriction device is then released around the base of the penis to keep blood in the penis and maintain the erection. A vacuum erection device can be used safely for up to 30 minutes, which is when the constriction device should be removed. The advantage of such a device is it is relatively inexpensive, easy to use and avoids drug interactions and side effects. Side effects may include temporary penile numbness, trapping semen within the penis due to the ring, and some bruising. Some men also report that the erection they obtain with the device feels somewhat artificial.

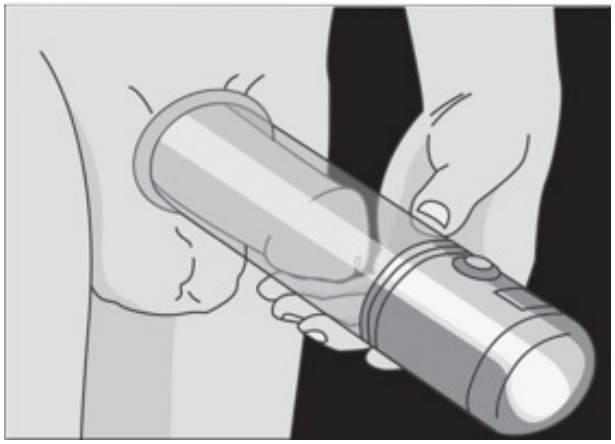

Figure 6: Vacuum Erection Device

Figure 7: Example of a three piece inflatable penile prosthesis

Penile prosthesis

For men with erectile dysfunction who have failed or cannot tolerate other treatments, a penile prosthesis offers an effective, but more invasive alternative. Prostheses come in either a semi-rigid form or as an inflatable device. Most men in the US prefer the placement of the inflatable penile prosthesis as this permits a more natural appearance in the flaccid (non-erect) position.

The placement of the prosthesis within the penis is a surgery which typically requires the use of a general anesthetic. A skin incision is made either at the junction of the penis and scrotum, or just above the penis, depending on which prosthesis and technique is used. The spongy tissue of the penis is exposed and dilated; the prosthesis is then sized and the proper device is then placed inside the erectile tissue. The inflatable device – a pump that contains the inflation and deflation mechanism – is placed in the scrotum. The patient can control his erection at will by pushing using the hydraulic pump to inflate and a release button to deflate the device. As the nerves that control penile sensation are not injured, penile sensation and the ability to have an orgasm are typically maintained after placement.

Patient and partner satisfaction rates are as high as 85 percent in carefully selected and counseled men who have penile prosthesis placement. Full penile length might not be restored to the patient's natural erect status. Rare side effects include infection, pain and device malfunction or failure.

Causes of ED

ED can be due to psychogenic, neurogenic, vascular or drug-induced factors, or a combination these factors. Many medical conditions have been associated with ED. (See Table I)

Table VI: Causes of ED

Category of ED	Conditions associated with ED
Psychological	• Depression • Schizophrenia • Performance anxiety • Stress • Relationship problems
Neurogenic	• Stroke • Pelvic surgery, injury or radiation • Spinal cord injury • Diabetic neuropathy
Vascular	• Atherosclerosis • Smoking • Hypertension • Diabetes • Trauma • Pelvic surgery, injury or radiation • Peyronie's disease
Hormonal	• Hypogonadism (low testosterone) • Hyperprolactinemia (high prolactin)
Drug Induced	• Excessive alcohol consumption • Androgen deprivation (LHRH agonists, i.e. Lupron, Zoladex) • Anti-hypertensives • Anti-depressants
Other Conditions Associated with ED	• Older age • Diabetes • Chronic renal failure • Obesity • Peripheral vascular disease • Heart disease

Psychological Causes of ED

Common causes of psychogenic ED include depression and performance anxiety. Depression is associated with decreased energy, interest and decreased libido or desire. Performance anxiety, work stress or strained personal relationships can affect erectile function in both conscious and subconscious ways.

Neurogenic ED

Penile erection depends on an intact nervous system so any injury to the nervous system involved in erections may cause ED. Diseases such as Parkinson's disease, Alzheimer's disease, stroke or head injury can lead to ED by affecting the libido, or by preventing the initiation of the nerve impulses responsible for erections. Patients with spinal cord injuries will have decreased erections related to the extent of the injury. Patients who have undergone pelvic surgery such as radical prostatectomy, cystectomy or colectomy may have injury to the cavernous nerves that control erection. Long-standing diabetes may affect some nerves as well as causing ED.

Hormonal Causes of ED

Diseases and conditions that decrease circulating testosterone in the body, such as castration or hormonal therapy used to treat prostate cancer, will decrease libido and may make natural erections more difficult.

Vascular Causes of ED

Diseases such as high blood pressure, high LDL ("bad") cholesterol, low HDL ("good") cholesterol, heart problems, cigarette smoking, diabetes mellitus, and treatments such as pelvic irradiation to treat prostate, bladder and rectal cancers, may damage blood vessels to the penis over time. Patients with Peyronie's disease (scarring with curvature of the penis), trauma, diabetes, and/or old age may experience damage to the spongy tissue of the penis, causing the veins to be more "leaky," which can lead to ED.

Drugs and ED

Certain anti-depressants or anti-psychotics have been associated with ED, especially those drugs that regulate serotonin, noradrenaline and dopamine. Examples include Prozac, Zoloft and Paxil. Beta-blockers and thiazide agents used to treat hypertension are associated with ED.

Cimetidine, a drug to treat acid reflux disease; chronic alcoholism; estrogens and drugs with anti-androgen action such as ketoconazole, and spironolactone can cause ED, decreased libido and male breast enlargement. Many drugs of abuse are also associated with ED. (See Table VII)

Aging and diseases which cause ED

Aging causes a progressive decline in sexual function even in healthy men. Medical studies have discovered that as men age, there is a decrease in turgidity, or "stiffness," of erections as well as a decrease in the force and volume of ejaculation. Also, with normal aging, there is an increase in the length of time a man requires to have another erection after experiencing orgasm, called the refractory period. Furthermore, the sensitivity to touch decreases over time as do serum testosterone levels, with an associated decrease in desire.

Health Conditions associated with ED

ED is very common in men with diabetes, liver cirrhosis, chronic renal failure, and many other chronic medical issues.

Table VII: Drugs Associated with ED

Class of Drug	Drug
Antihypertensive	• Clonidine • Reserpine • Beta-blockers (atenolol, propranolol, metoprolol) • Verapamil • Guanethidine
Anti-androgens	• Ketoconazole • Cyproterone acetate • Estrogen • Flutamide • Finasteride • Gonadotropin releasing hormone agonists (Lupron, Zoladex)
Cardiac Drugs	• Digoxin • Gemfibrozil • Clofibrate
Diuretics	• Thiazides (Hydrochlorothiazide) • Spironolactone
H2 antagonists	• Cimetidine • Ranitidine
Antidepressants	• Tricyclic (migraine) • Serotonin Reuptake Inhibitors (Prozac, Zoloft, Paxil) • Phenothiazines • Benzodiazepines (Valium, Xanax) • Meprobamate • Barbiturates • Lithium
Other Drugs	• Narcotics • Baclofen • Nonsteroidal anti- inflammatory drugs • Tobacco • Alcohol • Marijuana

Mechanisms of Penile Erection In Summary

The cavernous nerves travel from the underside of the penis to the prostate. These nerves regulate blood flow within the penis during erection and flaccidity. In the flaccid state, inflow through the arteries is minimal and there is free outflow via the small veins exiting the spongy tissue just under the thick tunica (thick membrane surrounding the spongy tissue). During erection, the smooth muscle in the penis relaxes while the arteries widen to pump in more blood that expands the three cavities of the penis – also called sinusoidal spaces – to lengthen and enlarge the penis. The expansion of these cylinders compresses the small veins and reduces the outflow of blood.

(Lue, T.F., Erectile Dysfunction. New England Journal of Medicine. June 15,2000. 1802-1813.) Reprinted with Permission from the Massachusetts Medical Society

The processes of penile erection are driven by the action of nerves and blood vessels. Hormones such as testosterone also play an important role. Finally, a man's psychological state and the health of his relationship with his partner are critical determinants of sexual response. Men who have stress, anxiety, and depression will tend to have high levels of activation in their sympathetic nervous system; this is a natural response to any form of stress. However, that stress tends to restrict blood flow into the penis and can make erections difficult or impossible to obtain. Careful attention to both mental and physical health is important in preserving erectile function.

Further Explanation

A normal erection requires the penis' nerves and blood vessel systems to be intact. Nerves that travel to the penis include fibers from the autonomic nervous system – the part of the nervous system that functions independent of our conscious thought – and the somatic nervous system – the nervous system responsible for sensation and contraction of muscles attached to the penis.

1) The autonomic nervous system controls the smooth muscle in the penile blood vessels, prostate and urinary sphincters that is important for initiating penile erection and facilitating ejaculation. The autonomic nervous system includes two parts. The sympathetic division tends to restrict penile blood flow but is important for closing the bladder neck to prevent urine leakage during sex. The parasympathetic division increases penile blood flow and stimulates penile erection. Coordination of these two components of the autonomic nervous system is critical for sexual response.

2) Sensory nerves travel to the glans (head) and shaft of the penis; these nerves are responsible for conveying sensations such as touch, temperature, and pain to the brain and may be important for stimulating sexual responses.

3) Motor nerves control contraction of the ischiocavernosus and bulbocavernosus muscles that are necessary to produce a fully rigid erection and to eject semen during ejaculation. (Figure 8)

   With sexual stimulation, parasympathetic cavernous nerves release chemicals (primarily nitric oxide) that significantly increase blood flow to the penis. The erectile tissue of the penis rapidly fills with blood and expands, becoming firm and erect. With increasing sexual arousal, the somatic nervous system causes the bulbocavernosus and ischiocavernosus muscles of the penis to contract, forcing additional blood into the penis and making it very rigid. At peak sexual arousal, the sympathetic nervous system causes contraction of the prostate and seminal vesicles, leading to emission, which is deposition of seminal fluid into the urethra. The sympathetic nervous system also makes the bladder sphincter close, preventing the semen from leaking into the bladder. As the amount of fluid builds in the urethra, pressure increases and the sensation of the inevitability of ejaculation is experienced. The bulbocavernosus muscle (under control of the somatic nervous system) then contracts and expels the semen forcibly from the urethra. Orgasm normally coincides with ejaculation.

Detumescence, or loss of erection, occurs shortly thereafter as the nerves stimulating penile erection cease releasing the molecular signals that trigger erection.

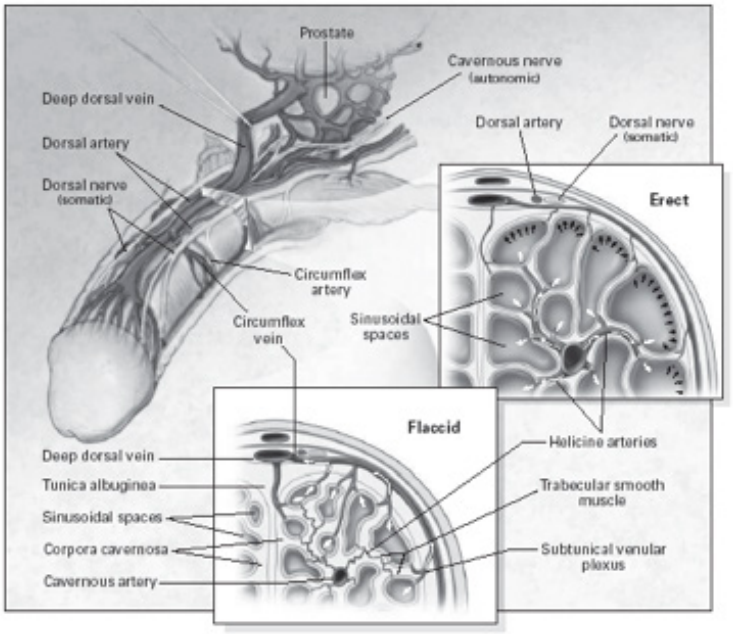

Figure 8: Mechanism of Erection

Future Directions

Innovative research over the past several years has resulted in significant strides and improvement in understanding the anatomy and physiology of sexual function. For instance, increasing knowledge about details of the cavernous nerves in the pelvis led to refinement of nerve-sparing prostatectomy. Understanding the biochemistry of normal sexual functioning led to the development of medications including Sildenafil, Cialis, Stendra and Levitra.

Current research is focusing on further understanding of the specific physiologic pathways responsible for normal sexual function, developing new, more effective agents for managing ED and understanding how cavernous nerves heal and what factors can hasten the healing process. Use of “gene” or “stem cell” technology may be possible in the future, allowing men and their partners to enjoy better sexual health.

Additional Resources

Books

Saving Your Sex Life, A Guide for Men with Prostate Cancer by John Mulhall 2010

Going the Distance: Finding and Keeping Lifelong Love by Lonnie Barbach and David K. Geisinger, Plume, 1993

Wonderful and realistic book about maintaining intimacy.

Hold Me Tight, Seven Conversations For a Lifetime of Love by Sue Johnson, NY, 2008

Stellar book on couples communication and intimacy.

Intimacy and ED: The Couple's Guide To Better Sex After Prostate Disease by Ralph Alterowitz and Barbara Alterowitz, De Capo Lifelong Books, 2004

Written in an honest compassionate style by a patient with prostate cancer and his wife. Discusses ED in non-medical terms with information about commercial treatments. Gives practical advice about making love. Includes everything from getting into the mood to common sense suggestions for having sexual satisfaction and intimacy when erections are not possible.

The Lovin' Ain't Over: The Couple's Guide to Better Sex after Prostate Disease by Ralph and Barbara Alterowitz. Health Education Literary Publisher, Westbury, NY, 1999

Man Cancer Sex by Anne Katz, Hygeia Media, 2010

Men, Women, and Prostate Cancer: A Medical and Psychological Guide for Women and the Men They Love by Barbara Rubin Wainrib, Michael Droller, Jack Maguire, and Sandra Haber, New Harbinger Publications, Inc., Oakland, CA, 2000

Websites

http://urology.ucsf.edu/patient-care/cancer/prostate-cancer

www.prostatecancerfoundation.org

The Prostate Cancer Foundation funds high impact research to find better treatments and a cure for prostate cancer.

www.ustoo.org

Us TOO International Prostate Cancer Education and Support Network.

www.menshealthnetwork.org

Men's Health Network (MHN) is a non-profit educational organization comprised of physicians, researchers, public health workers, individuals, and other health professionals.

Other Sources

American Association for Marriage and Family Therapy 112 South Alfred Street, Alexandria, VA 22314-3061; Phone: (703) 838-9808; Fax: (703) 838-9805

American Association of Sex Educators, Counselors, and Therapists P.O. Box 5488, Richmond, VA 23220-0488; Phone: (804) 752-0026; www.aasect.org

American Cancer Society Phone: (800) 227-2345; www.cancer.org

CancerCare, Inc. Phone: (800) 813-HOPE, (213) 712-8400; www.cancercare.org

https://www.urologyhealth

The official foundation of the American Urological Association

Managing ED Questionnaire

Please take a few minutes to answer the following questions. Your answers will help improve future editions of this guide.

Please check the appropriate box:

Statement	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Overall, the guide was helpful	❑	❑	❑	❑	❑
The information was presented clearly and in a way that was easy to understand	❑	❑	❑	❑	❑

Statement	Too much	Just right	Too little
The amount of information presented was:	❑	❑	❑

What was most helpful about the Guidelines?

_____

_____

_____

What was least useful about the Guidelines? Why?

_____

_____

_____

Should anything have been made more understandable?

_____

_____

_____

Should anything be added, or discussed in more detail?

_____

_____

_____

Was anything in conflict with what you already know about erectile dysfunction?

_____

_____

_____

If you would like to talk about the Managing ED Guide with a member of the group that prepared it, please write your name and phone number at the bottom of the questionnaire and one of the authors will contact you.

Please detach the questionnaire and either bring it in to the reception desk in the Uro-Oncology Department at the UCSF Comprehensive Cancer Center or mail it to:

Your Health Matters, Managing ED – A Patient Guide Department of Urology, Box 1695
University of California, San Francisco San Francisco, CA 94143-1695