Erectile dysfunction
Functional anatomy of penis

- The penis is composed of three cylindrical structure paired corpora cavernosa and corpus spongiosum which houses the urethra.
- The penis is covered by skin, dartos fascia, bucks fascia, tunica albuginea
- The corpora cavernosa communicate freely through incomplete septum
- Penile length 8 cm flaccid, 12.5 stretched and 12.9 erected from penopubic junction
• Tunica albuginea give flexibility and rigidity of the penis
• It is composed of elastic tissue which allow tunical expansion and collagen fibers(type 1)
• It consists of outer longitudinal layer and inner circular layer
• Emissary vein run between the two layer for short distance
• The corpora cavernosa contain trabeculae which is smooth muscle and fibrous tissue surround endothelial lined sinusoid

• The corpus spongiosum and the glans are the same except that the sinusoides are larger and the tunica albuginea is thinner in spongiosum (no longitudinal layer) and absent in the glans
• Blood supply to the penis is from internal pudendal artery, a branch of internal iliac artery
• IPA become penile artery after giving branch to perineum
• Penile artery gives 3 branches
• 1- dorsal artery for glans engorgement
• 2- bulbourethral artery for corpus spongiosum
• 3-cavernous artery: run in the center of CC and give helicin branches for the sinusoids
• Venous drainage start from peripheral sinusoids > subcutaneous venous plexus > emissary vein > branches of internal pudendal vein
• The innervation of the penis is both autonomic and somatic
• Sympathetic arise from T11-L2 spinal segment and release nor epinephrine to induce detumescence
• Parasympathetic arise from second third and fourth sacral spinal segment and release NO to induce tumescence
• Both join at the pelvis to form pelvic plexus which give cavernous nerve that supply the penis
• The somatic supply to the penis is through the pudendal nerve
• It carry sensory input from the penile skin and give motor supply to ischiocavernosus muscle ,and bulbocavernosus
• Ischiocavernosus muscle: Pumps blood distally to hasten erection and additional penile rigidity (rigid erection phase)
• Bulbocavernosus muscle: compress the bulb to expel semen
• Corpus spongiosum: constrict the urethra to allow forceful expulsion of semen
• Glans: cushion in intercourse, sensory input to induce erection, facilitate intercourse due to its cone shape
Mechanism of erection

• Audiovisual stimuli or tactile stimuli lead to signal from brain which activate the autonomic nuclei from spinal erection center
• this triggers increase blood flow to sinusoidal space by arteriolar dilatation and relaxation of cavernosal smooth muscle (which contracted unlike other muscle)
• Expansion of sinusoidal space against rigid tunical albuginea cause compression of subtunical vein
• Stretching of tunica cause compression of emissary vein
• Ischiocavernosus muscle contraction result in rigid erection
• During full erection the intracavernous pressure reach 100 mm HG
• During rigid erection the pressure reach hundreds of mm HG
• Detumescence results when erectile neurotransmitter release stops, when there is breakdown of second messengers by phosphodiesterases, or due to sympathetic discharge during ejaculation
Nitric oxide is likely the principal neurotransmitter for penile erection.

- It is released from non adrenergic non cholinergic parasympathetic nerve ending and from the endothelium
- L arginin---NOS---NO
- NO activate guanylate cyclase that convert GTP into cGMP
Which decrease intracellular calcium and so relaxation. On return to the flaccid state, cyclic GMP is hydrolyzed to 5 GMP by phosphodiesterase type 5.

Sildenafil, vardenafil, and tadalafil are drugs to treat erection dysfunction and they work by blocking phosphodiesterase enzyme activity.
• Medial preoptic area and paraventricular area in hypothalamus act as processing center that receive and send message from different part of brain and spinal cord.

• Centrally dopamin and noradrenalin induce erection while serotonin inhibit erection.
• Erectile dysfunction is defined as the inability to achieve and maintain an erection sufficient for satisfactory sexual intercourse..

• ED is generally divided into organic or psychological causes or mixed

• Overall prevalence between men aged 40-70 is estimated to be 50%
• Psychogenic cause: performance anxiety, depression, stress... by direct inhibition of spinal erection center by brain, excessive sympathetic outflow

• Neurogenic: any disease affect the brain, spinal cord, cavernous or pudendal nerve

• Like MS, CVA, Parkinson, spinal cord injury, post pelvic surgery, DM

• Arteriogenic: CVD, obesity, DM, HTN, smoking....
• Venogenic: penile fracture, peyronie disease
• Drugs: antihypertensive (thiazide diuretic, beta blocker, ), antipsychotic and SSRI, anxiolytic and anticonvulsant
• Smoking, alcohol, marijuana
• Anti androgen
• Endocrin problem: hypogonadism (decrease level of testosterone which important for libido and promote endothelial cell survival
• Hyperprolactinemia lead to inhibition of GNRH and so decrease testosterone
• Both hypo or hyperthyroidism cause ED
• Systemic disease such as CRI, liver cirrhosis
• Chronic prostatitis BPH or prostate surgery
Evaluation

• *History:*
• *Sexual history:* onset, duration, primary vs secondary
• Sexual desire, orgasm, ejaculation
• Morning erection or situational erection
• *Psychosocial:* social stress, relationship details, performance anxiety, mental health problem (depression)
• *Medical history:* chronic medical condition (DM, HTN, IHD...)
• History of trauma and drug history
• Sudden onset and complete immediate loss, situational dysfunction, presence of morning erection indicate psychogenic cause.
• IIEF5: international index of erectile function
To specify the severity of erectile dysfunction (no, mild, mild to moderate, moderate, severe) five question each question with 5 points
• *Physical examination:* BMI, blood pressure and signs of CVD

• Detection of micropenis, penile curvature

• Abnormal size of testis and secondary sexual characteristic (gynecomastia, decrease in muscle mass and increase in body fat, low hair distribution) indicate hypogonadism.

• Abnormal genital sensation or bulbocavernous reflex indicate peripheral neuropathy

• Bulbocavernous reflex test pudendal nerve
• *Lab test:*
  • Serum glucose, CBC and creatinin, lipid profile, and serum total testosterone
  • Testosterone best measured at early morning and if abnormal we measure free testosterone and LH
  • Prolactin and thyroid function test
  • PSA
• **Special test:**
• Combined intracavernous injection with stimulation: it involves intracavernous injection of vasodilatory drug with video stimulation
• It relies on assessor judgment
• If normal psychogenic or neurogenic or endocrinogenic cause is considered
• Duppler U/S: the same of previous one but rely on image to assess the blood flow
• We measure the peak systolic velocity, if more less than 25 cm/sec indicate arteriogenic cause, and if more than 35 indicate non arteriogenic
• Cavernosography: it involve injection of radio opaque substance into corpus cavernosum, in normal veno occlusive mechanism there will be no opacification of corpus spongiosum or penile vein
• Nocturnal penile tumescence and rigidity: rigiscan
• Nocturnal erection occur during REM sleep
• It measure the number of episodes and rigidity and duration of erection
• Normaly 4-5 episodes, longer than 30 minutes, 2cm and 3cm increase in width at the tip and base respectively
Treatment

• Lifestyle Changes:
  • Healthy lifestyle changes like quitting smoking, losing excess weight, and increasing physical activity
• Discontinuing drugs with harmful side effects
• Psychotherapy: decreasing the anxiety associated with intercourse., collaboration with mental health clinician
• Hormonal therapy : testosteron replacement
• Drug therapy:
• PDE5 inhibitors: sildenafil, tadalafil, vardenafil
  they block breakdown of CAMP by phosphodiesterase
• Sexual stimulus is still required
• It augment but not induce erectile function
• Contraindication in ptn on nitroglycerin, and recent MI or stroke within last six months
• Intermediate and high risk for coronary disease needs cardiology assessment
• Side effect includes: headache, flushing, nasal congestion and muscle pain, visual disturbances

• Sildenafil and vardenafil start to work after 30-60 minutes and efficacy may maintained up to 12 hours and they are affected by fatty meal

• Tadalafil the efficacy maintained for 36 hours and not affected by fatty meal
• Intracavernous injection: alprostadil (PGE), papaverin (non selective phosphodiesterase inhibitor), phentolamin (alpha blocker)
• Side effect pain and priapism
• Intraurethral Injections: inserting a pellet of alprostadil into the urethra (MUSE)
• Vacuum Erection Devices:
• Mechanical vacuum devices induce erections by creating a partial vacuum, which draws blood into the penis, engorging and expanding it.
• 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 band, which is placed around the base of the penis to maintain the erection after the cylinder is removed and during intercourse by preventing venous return
• Penile implant: Inflatable implants consist of paired cylinders that are surgically inserted inside the penis and then expanded using pressurized fluid from a co-implanted fluid reservoir and a pump.

• Malleable implants consist of paired solid rods, which are inserted surgically into the corpora cavernosa.

• Complications include mechanical breakdown, erosion and infection.
Priapism

• Priapism is a persistent penile erection that continues hours beyond, or unrelated to, sexual stimulation and lasting for at least 4 hours.

• There are two types of priapism ischemic (low flow) the most common and non ischemic (high flow) the least common
Ischemic Priapism

Men with ischemic priapism present with a painful, and fully rigid erection, while the erection is not rigid and painless in non ischemic type

Corporeal blood aspiration and sending for blood gas analysis to document PH, oxygen, CO2 help to differentiate between the two types

- In IP there will be PO2<30, PCO2>60, PH<7.25
- In non IP PO2>90, PCO2<40, PH 7.4
• Penile doppler u/s will show no arterial inflow in cavernous artery in case of IP
• IP mostly idiopathic
Sickle cell trait or disease (most common cause in children)
Malignant tumor (notably leukemia)
  intracavernous injections, alpha blockers, anticoagulants, trazodone, recreational drugs)
Neurologic shock
• Non IP result from fistula between the cavernous artery and sinusoides, usually from blunt perineal or penile trauma or needle injury or iatrogenic during penile surgery
• Which result in high inflow without decrease of outflow
management

• Non ischemic priapism is managed conservatively with perineal ice application, and definitive management with embolization lateron

• Ischemic priapism is managed with aspiration and irrigation, if failed phenylphrin injection (alpha agonist), if failed surgical shunting or penile implantation if more than 36 hours
Penile fracture

• Tear of tunica albuginea occur during powerful intercourse when rigid penis slips out vagina and strikes the perineum or pubic bone producing buckling injury.

• the tear is usually transverse , and ventral or lateral where the tunica is thin

• The patient reports popping sound followed by pain and detumescence and swelling with ecchymosis of penile shaft (eggplant deformity)
• The urethral injury is suspected in case of bilateral tear and blood at tip of urethral meatus
• If urethral injury is suspected retrograde urethrogram is done before follicys catheter
• Management is exploration evacuation of hematoma and closure of the tear
• When compared with conservative MX surgical repair decrease complication and morbidity, lower the incidence of curvature and erectile dysfunction