Penile Ultrasound

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Penile Ultrasound Anatomy
- Phallic consists of the two corpora cavernosa (cc) and the corpora spongiosum (cs) which surrounds the urethra. All three covered by the tunica albuginea
- The two penile arteries arise from branches of the internal pudendal arteries giving rise to:
  - Penile bulbar artery
  - Urethral artery
  - Superficial dorsal artery
  - Deep penile artery which within the cc branch into helicine arteries which open into the sinusoids.
- The cc are drained by subtunical veins that empty into the deep dorsal vein

Scanning Terminology

Penile Orientation

Orientation

Physical Principles
Ultrasonography
- Pulsed Wave Doppler (PW)
  - Single crystal, phase shift measured, speed:direction:depth
- B-mode (gray scale)
- Color Doppler (Duplex)
  - Speed and direction encoded in color as indicated by the color bar (BART)
- Spectral Doppler (Triplex)
  - Spectrum of flow velocities represented graphically on the Y-axis and time on the X-axis

Scanning Protocol - overview
penile ultrasound - overview
- High resolution grey scale imaging with transducers from 7 to 18 mHz
- Color and spectral Doppler capabilities are essential
- Transverse and longitudinal views obtained from ventral and/or dorsal surfaces
  - Survey Scan (Video Clips)
  - Specific Images (Proximal, Mid, Distal, Lateral)
- The specific measurements obtained should be documented on the images.
- The specific images obtained should document the findings discussed in the report.
Normal Imaging Documentation

- The report should include:
  - patient identification
  - date of examination
  - measurement parameters and anatomical findings of examination.
- The report is signed by the physician who performed the ultrasound examination.
- Indication for performing the examination is clear and provided on the report.

Images should include:
- patient identification
- date and time of each image
- Clear image with orientation and measurements
- Labeling of anatomy and any abnormalities
- Images should be attached to the report.

Indications

- Structural Pathology
  - Penile plaque
  - Peyronie’s plaque
  - Lateral fibrosis
  - Penile mass
  - Penile fracture
  - Penile tumor
  - Hematoma
  - Cavernoal herniation

- Vascular Pathology
  - Erectile dysfunction
  - Priapism
  - High flow
  - Low flow
  - Thrombosis

- Urethral Pathology
  - Diverticula
  - Abscess
  - Stricture
  - Calculus

- Post surgical follow up

Indications structural – Peyronie’s plaque

- Plaque may or may not be calcified
- May be better visualized with tumescence
- Arterial venous disease more common with Peyronie’s disease

Images/Measurements
- Thickness and length of the plaque
- Blood flow of the corpora cavernosa and corpora spongiosa

Indications structural - penile fracture

- Usually presents with pain, swelling and sudden loss of erections with intercourse
- Ultrasound is useful for initial diagnosis (hematoma, tunica albuginea defect) and long term follow up (corporal fibrosis, plaque formation)

Images/Measurements
- Width of defect
- Transverse and longitudinal image of defect
- Color flow confirmation of viable tissue

Indications structural - penile tumor

- Squamous cell carcinoma of penis confined to subepithelial tissue
- Tunica albuginea of the corpora cavernosa is intact

- Bladder cancer metastatic to penis with diffuse and nodular involvement (N) of the corpora cavernosa

Images/Measurements
- Width of defect
- Transverse and longitudinal image of defect
- Color flow confirmation of viable tissue
Indications

**structural - herniation of corpora cavernosa tissue**

- Congenital or acquired focal weakness in the tunica albuginea
- Herniation often results in failure of compression of the emissary veins and erectile dysfunction

**vascular - duplex basics**

- Measurements taken prior to and at 5 minute intervals after injection for at least 30 minutes:
  - Width - inner vessel diameter
  - Peak systolic velocity (PSV)
    - Erect phallus: 25 to 35 cm/s with > 35 cm/s normal and < 20 cm/s abnormal
    - Flaccid phallus: 5 - 20 cm/s
    - Asymmetry < 10 cm/s
  - End diastolic velocity (EDV)
  - Resistive (Resistance) Index (RI) = (PSV - EDV) / PSV
    - Erect phallus: falls below 0.7 at first then above 1.0 indicating bi-directional blood flow in the penile arteries
    - Flaccid phallus: ~1.0 (no detectable EDV)

**vascular - ED protocol**

- Informed consent is obtained
  - The need for the patient to call the physician should an erection last more than 4 hours from the time of injection must be emphasized and documented
- Supine position with scrotum supported
  - Dorsal, Ventral and Lateral approaches are employed
- High frequency (7 - 18 mHz) “small parts” transducer with small footprint
- Baseline imaging for fibrosis, plaque or other pathology
- Baseline measurements of inner cavernosal artery diameter and vascular parameters (PSV, EDV, RI)
  - Normal baseline velocity parameters (i.e., without pharmacologic stimulation) are often difficult to obtain and have not been well described

**vascular - blood flow with pharmacostimulation**

- Pharmacostimulation with single or combination agent (Papaverine, Phentolamine, Prostaglandin E-1)
- Vascular parameters and a clinical evaluation of tumescence and rigidity are measured at the base of the penis at 5 minute intervals for 30 minutes.
  - Erection must be dissipated prior to sending the patient home
    - Reported incidence of priapism > 11%
    - Absence of cavernous blood flow or a RI >1 (absent diastolic blood flow) often predicts post procedure priapism (J Cormio et al, Eur Urol, 33:94-97, 1998)
  - Follow up phone call with patient within 4 hours to confirm that the erection has dissipated
### Indications

**vascular - pre injection – Flaccid Phallus**
- Baseline PSV
- Baseline EDV
- Baseline cavernosal artery inner diameter
- Baseline (Subjective) Tumescence and Rigidity

**vascular - 5 min post injection**
- Measurements Obtained: every 5 minutes until RI ≤ 1 or high dose of injectable agent does not increase PSV further:
  - PSV
  - EDV (calculate RI)
  - Cavernosal artery inner diameter
  - (Subjective) Tumescence and Rigidity
  - Angle of Incidence

### Indications

**vascular - priapism**
- Low Flow
  - Deoxygenated corporal blood on aspiration
  - High RI with low (or no) diastolic flow
  - Edema
  - Medical Emergency
- High Flow
  - Oxygenated corporal blood on aspiration
  - Low RI with increased systolic and diastolic flow
  - Arteriovenous fistula may be present (with trauma)

### Indications

**vascular - arterial (“high flow”) priapism**
- High flow (arterial)
  - Arterial priapism: secondary to arteriovenous fistula, frank arterial laceration with extravasation or a pseudoaneurysm
  - Treatment: most effective- arterial ligation or percutaneous embolization. Less effective- perineal compression, ice packs or intracavernous administration of alpha-adrenergic agonists

### Assessing CVD risk in ED
- ED presents about 39 months before CAD possibly because the smaller penile arteries reach critical narrowing and decreasing blood flow earlier than larger vessels.
- A normal penile Doppler test virtually excludes CAD with a 98% negative predictive value.
- An abnormal penile Doppler test had a 30% positive predictive value for CAD – a value many times higher than 4% found in the general population.


### Assessing CVD risk in ED
- 77% of those with high-grade ischemic heart disease had an abnormal penile Doppler test with peak systolic velocity (PSV) of less than 25 cm/s.
- Those with angiographically confirmed silent CAD had over seven times the rate of ED (33.8% vs 4.7%) than control type II diabetics without CAD.
- As more information accrues confirming ED as an early manifestation of peripheral vascular disease, PDDU testing may play a key role in selecting those who do or do not need further coronary artery vascular assessment.
Assessing CVD risk in ED

- The physician evaluating ED has a unique opportunity to diagnose vascular impairment at a time when lifestyle changes and possible medical intervention have the potential to change morbidity and mortality of cardiovascular disease.
- As suggested by Miner there might be a "window of curability" in which the significant risk of future cardiovascular events might be averted through early diagnosis and treatment.


Indications
vascular - dorsal vein thrombosis

"Mondor’s phlebitis".
- Acute: inflammation, pain, fever
- Subacute: induration and minimal pain
- Spontaneous recanalization in 6 to 8 weeks

Indications
structural - urethral stricture

Normal
A. Radio-urethrography
B. Sono-urethrography

Urethral Stricture
A. Sono-urethrography
B. Color Doppler

M Mitterberger et al, J Urol, 177, 992-997, 2007