Duplex study of the cavernosal arteries in assessment of different causes of impotence

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Learning objectives

To evaluate mechanism and cause of erectile dysfunction with the aid of duplex US after intra-cavernosal injections of vasoactive agents

Background

Erectile dysfunction means the persistent of inability to initiate or maintain penile erection sufficient for sexual intercourse. Erectile Dysfunction is due to either psychogenic or organic cause. Organic causes are subdivided into vasculogenic, neurogenic and hormonal etiologies. Vasculogenic etiologies represent the largest group, with arterial disorders being the most common. [1]

the physiology of penile erection.

**Blood supply to penis** is through internal pudendal artery that gives cavernosal artery and further into helicine arteries, which pierce the cavernosal tissue. **Neurophysiology**

Erection is due to activation of the para-sympathetic system to the penis and inhibition of sympathetic that responsible for the contraction of corporal smooth muscle cells. [2]

On sexual stimulation, parasympathetic activity causes penile vascular smooth muscle relaxation. Blood flow is markedly increased into the corpora cavernosa. This causes rapid filling of the cavernosal spaces compresses venules resulting in decreased venous outflow, which is known as corporeal veno-occlusive mechanism. The combination of increased inflow and decreased outflow rapidly raises intra-cavernosal pressure resulting in progressive penile rigidity and full erection. [1]

Color Duplex ultrasound of the penis indicated for erectile dysfunction that provide objective vascular testing to permit diagnosis of the cause. It is indicated in young men with primary or secondary erectile dysfunction, differentiating psychogenic from organic erectile dysfunction and in medicolegal cases. [3]

Penile duplex Doppler is performed by a radiologist in a hospital setting. This is a dynamic test requiring intra-cavernosal injection (ICI) of a vasoactive agent [4].

Evaluation of Erectile Function including the following:

1. History and physical
   - Age, marital status, medical history, medications, smoking, etc.
   - Erectile function scoring.
1. Hormonal profile (testosterone), glucose, and lipid profile

Prediction of the Clinical Diagnosis of Patients (Normative Values)
The measurement of peak systolic velocity (PSV) to evaluate arterial competence allowed researchers to accept "normal" lower limits for the PSV between 25 and 30 cm/second. A PSV of 30 cm/second or greater indicates normal arterial flow after adequate pharmacological stimulation, whereas a PSV below 25 cm/second is diagnostic of arterial insufficiency as the cause of ED.

The end diastolic velocity (EDV) is informative about penile veno-occlusion. accept "normal" limits for the EDV is lower than 5 cm/second

Adequate arterial inflow with a semi-rigid erection of a short duration with persistent EDV of >6 cm/second (angle corrected) throughout all phases is suggestive of venous leakage.

The gold standard method of diagnosing venous leakage is by dynamic infusion cavernosometry and cavernosogrophy (DICC).

Findings and procedure details

Examination

1. Isolated, quiet room with dim light
2. Explain to the patient about the planned procedure and obtain informed consent.
3. Instruct the patient to assume a supine position.
4. Scanning the penis in longitudinal and cross-sectional views using B-mode image with 10 MHz linear array U/S probe. Observe cavernosal homogeneity, presence of plaques, or calcification. Inner diameter of intracavernosal arteries (both left and right)
5. Using a 27 gauge needle, injection of vasoactive agent (alone or a combination of PGE1, phentolamine, and/or papaverine) into the corpus cavernosum. Dorsoventral pressure at the base of penis for about 60 seconds to maintain most of the vasoactive agent in the penis.
6. By using Doppler mode, focus cursor in the artery, angle is adjusted (preferably 60°) to determine systolic/end-diastolic velocities (centimeter/second) at 5, 10, 15, and 20 minutes up to 30 minutes.
7. At near the peak response, intra-luminal diameters of the left and right cavernosal arteries are obtained.
8. After the procedure, maintain patient at the site for 0.5-1 hour to observe any untoward effects (e.g., onset of priapism)

**Findings**

**Normal response** is that PSV greater than 25 cm/sec and EDV lower than 5 cm/second.

PSV below 25 cm/second is diagnostic of **arterial insufficiency** as the cause of ED.

Persistent EDV of >6 cm/second (angle corrected) throughout all phases is suggestive of **venous leakage**.

**Images for this section:**

![Real-time Doppler ultrasound scan with B-mode image of left cavernosal artery showing normal peak systolic velocity of 55.5 cm/second with reversed end diastolic velocity at peak erection response, suggesting a nonvascular etiology](image)

**Fig. 1:** Real-time Doppler ultrasound scan with B-mode image of left cavernosal artery showing normal peak systolic velocity of 55.5 cm/second with reversed end diastolic velocity at peak erection response, suggesting a nonvascular etiology
**Fig. 2:** Real-time Doppler ultrasound scan with B-mode image of right cavernosal artery showing normal peak systolic velocity of 130 cm/second at peak erection response with reversed end diastolic velocity, suggesting a nonvascular etiology
Fig. 3: Real-time Doppler ultrasound scan with left cavernosal arterial blood flow with 15 cm/second Vps, end-diastolic velocity reversed, suggesting arterial etiology
**Fig. 4:** Real-time Doppler ultrasound scan with left cavernosal arterial blood flow with 14 cm/second, end-diastolic velocity reversed, suggesting arterial etiology
Fig. 5: Real-time Doppler ultrasound scan showing right cavernosal artery blood flow with normal (41 cm/ second), high end-diastolic blood flow of >10 cm/ second, suggesting a venous leakage etiology
Fig. 7: Real-time Doppler ultrasound scan with right cavernosal arterial blood flow with <25 cm/second, end-diastolic velocity of >11 cm/second, suggesting a mixed vascular etiology.
Fig. 8: Real-time Doppler ultrasound scan with right cavernosal arterial blood flow with <25 cm/second, end-diastolic velocity of >11 cm/second, suggesting a mixed vascular etiology
**Fig. 6:** Real-time Doppler ultrasound scan showing right cavernosal artery blood flow with normal (39 cm/second), high end-diastolic blood flow of >9 cm/second, suggesting a venous leakage etiology
Conclusion

duplex US is a gold standard method as a minimally invasive modality in diagnosis of the cause of erectile dysfunction.

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References


