Multimodality imaging of patients with Erectile Dysfunction and Peyronie’s disease

P. PAVLICA
Bologna - ITALY
Erectile Dysfunction

• Erectile dysfunction is the persistent or repeated inability of males to attain and/or maintain erection of the penis sufficient to permit satisfactory sexual performance.

• ED has a profound impact on the quality of life of many males and their partners and therefore deserves appropriate clinical evaluation and treatment.
Erectile Dysfunction

The Management of Erectile Dysfunction: An Update

Penile duplex ultrasound (DUS) may be combined with ICI to produce a more detailed and quantitative assessment of penile vascular response, including arterial sufficiency. DUS also permits observation of plaques and/or fibrosis of the tunica and corporal bodies. DUS is a nuanced procedure and should be performed and interpreted only by those urologists with extensive experience and training in the technique.

DUS is currently the gold-standard in penile vascular evaluation as it is minimally invasive and provides robust information about both cavernous arterial inflow and the veno-occlusive capacity of the penis. These data may be useful for the following:

- differentiation of primary psychogenic versus organic etiology for ED
- assessment of arterial function in men who may warrant assessment by a cardiologist (i.e., men with predominantly vascular ED)
- identification of men with severe veno-occlusive dysfunction resulting in ED who are unlikely to respond to medical therapy
EAU Guidelines on
Erectile Dysfunction,
Premature Ejaculation,
Penile Curvature and
Priapism

K. Hatzimouratidis (Chair), F. Giuliano, I. Moncada,
A. Muneer, A. Salonia (Vice-chair), P. Verze

3.1.3.2.2 Intracavernous injection test
The intracavernous injection test gives limited information about the vascular status. A positive test is a rigid erectile response (unable to bend the penis) that appears within 10 min after the intracavernous injection and lasts for 30 min [70]. Overall, the test is inconclusive as a diagnostic procedure and a duplex Doppler study of the penis should be requested, if clinically warranted.

3.1.3.2.3 Duplex ultrasound of the penis
A peak systolic blood flow > 30 cm/s, an end-diastolic velocity of < 3 cm/s and a resistance index > 0.8 are generally considered normal [71]. Further vascular investigation is unnecessary when a Duplex examination is normal.

3.1.3.2.4 Arteriography and dynamic infusion cavernosometry or cavernosography
Arteriography and dynamic infusion cavernosometry or cavernosography should be performed only in patients who are being considered for vascular reconstructive surgery [72].

3.1.3.2.5 Psychiatric assessment
Whenever clinically indicated, patients with psychiatric disorders should be referred to a psychiatrist who is particularly interested in sexual health. In younger patients (< 40 years) with long-term primary ED [30], psychiatric assessment may be helpful before any organic assessment is carried out.
Clinical Background

• The prevalence of ED is approximately 52% in men aged 40-70 years of age

• ED is observed in the same age group of patients with coronary artery disease (CAD)
How do we evaluate patients with ED?

- Intracavernosal prostaglandin injection associated with Doppler US has enabled diagnostic evaluation of vascular hemodynamic associated with penile erection
- The homodynamic changes may involve the arterial or venous component of erection

**Technique:** 10-20 μg of alprostadil intracavernosal injection
Parameters Measured During US-Scanning

- Arterial diameter and dilatation
- Peak systolic velocity
- End diastolic velocity
Normal spectral flow velocity
Arterial Peak Flow Velocity

- A velocity > of 35 cm/s is indicative of normal arterial function
- Border-line values between 25 and 35 cm/s
- Less than 25 cm/s is indicative of arteriogenic ED
- During the rigid phase blood velocity is lower than in the initial phase
Arteriogenic ED

• No erection after 30 minutes from injection
• Peak systolic velocity < 25 cm/s
• Probable arteriogenic EC when < 35 cm/s
• Usually high diastolic flow
Arteriogenic ED

Low peak systolic velocity
ED secondary to small corporeal arteries pathology
Veno-occlusive ED

- In patients with normal arterial flow but weak erection, venous leakage can be suspected.
- Persistently elevated diastolic flow in the cavernosal artery is indicative of venogenic ED, secondary to endothelial dysfunction.
- Cut-off value is 5 cm/s.
- There is a good correlation between diastolic velocity and dynamic cavernosography in venogenic ED.
- An increased flow in the dorsal vein is not indicative of venous leakage.
Veno-occlusive ED

- High peak systolic velocity
- Normal arterial caliber
- High end-diastolic flow 20 minutes after intracavernosal injection
A new perspective:

ED is regarded as one of the first clinical parameters of increased risk of significant CAD or peripheral vascular disease (early manifestation of endothelial dysfunction and atherosclerosis).
Conclusions

• ED is a prevalent health problem and impacts considerably on the quality of life of middle-aged men

• Color-Doppler US with vasoactive drugs has replaced other imaging modalities in patients with ED

• Radiological imaging (areriography, cavernosography) are performed only if the ED could be treated by transluminal angioplasty or venous surgery
Peyronie’s Disease

• Definition
  • There is no universal consensus on the definition
  • Peyronie’s disease is a combination of penile pain, deformity and/or palpable plaque
  • Curvature is the most common deformity, penile shortening and other malformations can occur
  • The etiology is unknown but penile microtrauma plays a major, if not exclusive role in the development of the plaque
### EAU Guidelines on Penile Curvature

**Konstantinos Hatzimouratidis**, [a,b], **Ian Eardley**, [b], **François Giuliano**, [c], **Dimitrios Hatzichristou**, [a], **Ignacio Moncada**, [a], **Andrea Salonia**, [c], **Yoram Vardi**, [d], **Eric Wespes** [g]

#### Table 3 – Summary of recommendations on the evaluation of Peyronie's disease

<table>
<thead>
<tr>
<th>Guidelines recommendations on the evaluation of Peyronie's disease</th>
<th>LE</th>
<th>GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical and sexual histories in patients with Peyronie's disease must include duration of the disease, penile pain, change of penile deformity, difficulty in vaginal intromission due to deformity, and erectile dysfunction.</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Physical examination must include assessment of palpable nodules, penile length, extent of curvature (self-photograph, vacuum-assisted erection test, or pharmacologically induced erection) and any other possibly related diseases (Dupuytren contracture, Ledderhose disease).</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Sonographic measurement of the plaque's size is inaccurate and operator dependent. It is not recommended in everyday clinical practice. Duplex ultrasonography is required to ascertain vascular parameters associated with erectile dysfunction.</td>
<td>3</td>
<td>C</td>
</tr>
</tbody>
</table>

**LE** = level of evidence; **GR** = grade of recommendation.
Peyronie’s Disease: AUA Guideline

American Urological Association Education and Research Inc., Linthicum, Maryland

Abstract

Purpose—The purpose of this guideline is to provide a clinical framework for the diagnosis and treatment of Peyronie’s disease.

Diagnosis

1. Clinicians should engage in a diagnostic process to document the signs and symptoms that characterize Peyronie’s disease. The minimum requirements for this examination are a careful history (to assess penile deformity, interference with intercourse, penile pain, and/or distress) and a physical exam of the genitalia (to assess for palpable abnormalities of the penis). (Clinical Principle)

The clinician should meticulously elicit the patient’s history of penile symptoms, including onset, precipitating factors, duration, changes over time, prior treatments used, and other conditions (e.g., ED) that may affect treatment options. A careful examination of the genitalia should be performed that includes stretching and palpation of the flaccid penis and documentation of circumcision status and any anomalies (e.g., hypospadias).

2. Clinicians should perform an in-office intracavernosal injection (ICI) test with or without duplex Doppler ultrasound prior to invasive intervention. (Expert Opinion)

The ICI test enables assessment of penile deformity, plaque(s), and pain in the erect state. When the ICI test is combined with duplex ultrasound, additional measurements of plaque size and/or density can be made, calcified and non-calcified plaques can be differentiated, and information on the vascular integrity of the penis can be obtained.
Pathology

- Peyronie’s plaques appear histologically and biochemically to result from inflammation of the tunica albuginea
- The inflammatory process healing leads to fibrosis, loss of elastic tissues and excessive collagen deposition
- These may account for the initial pain and subsequent plaque development and deformity
IMAGING IN PEYRONIE’S DISEASE

- Conventional Rx:
  - plain film
  - cavernosography
- Gray-scale Sonography
- Color-Power Doppler Ultrasonography
- CT imaging
- MR without/with contrast medium
CONVENTIONAL RX

PLAIN FILM

• Detects only calcified plaques
• It does not detect the fibrous plaques
• It can not differentiate calcifications of different origin
CONVENTIONAL RX

CAVERNOSOGRAPHY
- It shows the indirect signs of the plaques
- Depicts well septal plaques
- Not easy to detect dorsal plaques
- It is invasive
Gray scale Sonography

• Is the modality of choice
• The plaques are better defined during erection or tumescence after PGE1 injection
Gray scale Sonography

Thickess

Length

Calcification size

Calcification number
US of the Peyronie’s plaque

Involvement of the septum
US of the Peyronie’s plaque

- Focal thickening of the tunica albuginea
- Interruption of the line corresponding to the albuginea
- Localized hyperechoic area of thickening of the albuginea
- Thickening of the septum
- Reduced distension of the corpus cavernosum under the plaque
- Calcifications
Magnetic Resonance of the Penis

- Is the second imaging method used in clinical practice
- The technique is more complex vs sonography
- It needs a specific training of the RT and the radiologist
- Is more time consuming and more unpleasant for the patient
- It is more expensive
MR imaging of the Penis Technique

- Appropriate patient positioning: supine
- Intracavernosal injection of 10 mcg of PGE1
- Penis dorsiflexed against the lower abdomen in the midline
- The erect penis is taped in position to reduce organ motion during examination
MR imaging of the Penis
Technique
MR imaging protocols

- T2 images with fat suppression increase the dynamic range and the differences in signal intensity can be easier detected.
- MR angiography is not commonly performed if the pt has no erectile disfunction.
- Contrast injection is used in selected cases.
NORMAL MR ANATOMY

- T1 images corpora are of intermediate signal intensity
- On T2 images corpora are hyperintense because of slow vascular flow
- Tunica albuginea appears as a rim of low intensity signal
MR of Peyronie’s plaque

- The plaques appear as thickened and irregular low intensity areas of tunica albuginea on T1 and T2 images
MR imaging in sagittal scan
MR imaging in axial scan
CONCLUSIONS

- US is the first line and the most diffuse method to detect and measure the Peyronie’s plaques and calcifications.
- It is rapid, simple but requires pharmacological stimulation.
- The MR imaging is rarely used in clinical practice, is panoramic and easy to be interpreted by non expert in sonography.
- It has not shown a superior ability in detecting plaques compared to US.
- It shows better the extent of plaque to the corpora and septum. It is used as guide to surgical planning or to measure the therapeutic response to conservative treatments.