Standardization of Vascular Assessment of Erectile Dysfunction

Standard Operating Procedures for Duplex Ultrasound

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DOI: 10.1111/j.1743-6109.2012.02825.x

ABSTRACT

Introduction. In-office evaluation of erectile dysfunction by color duplex Doppler ultrasound (CDDU) may benefit the decision-making process in regard to choosing the most appropriate therapy. Unfortunately, there is no uniform standardization in performing CDDU resulting in high variability in data expression and interpretation when comparing results among various centers, especially when conducting multicenter trials. Establishing standard operating procedures (SOPs) is a major step that will help minimize such variability.

Aim. This SOP describes CDDU procedure with focus on establishing uniformity and normative parameters.

Main Outcome Measure. Measure intra-arterial diameter, peak systolic velocity, end-diastolic velocity, and resistive index for each cavernosal artery.

Methods. After initial discussion with the patient about his history and International Index of Erectile Function evaluation describe procedural steps to the patient. Perform the CDDU in a relaxed state, scanning the entire penis (in B-mode image) using a 7.5- to 12-MHz linear array ultrasound probe. An intracorporal injection of a single or combination of vasoactive agents (e.g., prostaglandin E1, phentolamine, and papaverine) is then administered and CDDU performed at various time points, preferably with audiovisual sexual stimulation (AVSS).

Results. Monitor penile erection response (tumescence and rigidity) near peak blood flow. Self-stimulation or AVSS leaving the patient alone in room or redosing may be considered to decrease any anxiety and help achieve a maximum rigid erection.

Conclusion. Considering the complexity and heterogeneity of CDDU evaluation, this communication will help in standardization and establish uniformity in such data interpretation. When indicated, invasive diagnostic testing involving (i) penile angiography and (ii) cavernosography/cavernosometry to establish veno-occlusive dysfunction may be recommended to facilitate further treatment options. **Sikka SC, Hellstrom WJG, Brock G, and Morales AM. Standardization of vascular assessment of erectile dysfunction. J Sex Med 2013;10:120–129.**

Key Words. Penile Doppler Ultrasound; Erectile Dysfunction; Standard Operating Procedures

Introduction

In the era of highly effective orally active agents for the treatment of erectile dysfunction (ED), dynamic color duplex Doppler ultrasound (CDDU) of penis, first described by Lue et al. [1], is not mandatory for evaluating all ED patients. While CDDU is an objective and reliable diagnostic method for documenting penile hemodynamics, it requires skilled personnel and modern equipment that may be cost prohibitive in certain settings. Objective vascular testing that provides a physiologic diagnosis may help direct appropriate therapy because not all patients respond adequately to oral ED therapy [2,3]. Reasons for this lack of response are often unclear as medical history and standardized questionnaires (e.g., International

Subject Area: Vascular physiologic studies of genital arousal < Clinical Diagnosis < MALE.

Index of Erectile Function [IIEF] [4] used for evaluating ED can be misleading. Other cases where CDDU of the penis is, or might be, necessary to complete the evaluation include young men with primary or secondary ED and a history of pelvic trauma or drug abuse, prior to surgical interventions for treating Peyronie's disease, differentiating psychogenic vs. organic ED, and in medicolegal cases. ED can be the first presenting symptom of multi-organ endothelial dysfunction. Certain comorbidities associated with one or more risk factor(s) may require further hemodynamic investigation and in selected cases this can be followed by an invasive penile angiographic evaluation. The lack of standardized measures often prevents accurate clinical diagnosis of a patient undergoing hemodynamic assessment of the penis by CDDU [5]. This leads to variability in data interpretation when comparing the results between various centers, especially in multicenter trial formats. Establishing standardized operating procedures (SOPs) may minimize or eliminate such variability. The overall goal of an SOP for CDDU is to help predict, with reasonable accuracy, the clinical diagnosis of an ED patient undergoing hemodynamic assessment of the penis (Section 1). This SOP also presents basic standards of penile (pudendal) angiography, the most invasive diagnostic test for evaluating arterial blockage, in a case report format with specific arteriograms (Section 2). The other invasive diagnostic test, cavernosography/cavernosometry, to establish veno-occlusive dysfunction (Section 3) has been mentioned in brief and is described in more detail as a separate SOP manuscript.

Duplex Ultrasound (U/S) Penile Blood-Flow Evaluation

Establishing SOPs

In general, penile duplex Doppler is performed by an experienced sonographer in a physician's office or by a radiologist in a hospital setting. This is a dynamic test requiring intracavernosal injection (ICI) of a vasoactive agent [5–7]. Thus, it is important to understand some aspects of the physiology of penile erection, evaluation, causes of variability, and interpretation.

Erectile Physiology

A) Blood supply to penis
   i) Mainly via the internal pudendal artery that branches into the cavernosal artery (deep penile artery) and further into helicine arteries, which penetrate the cavernosal tissue, or into A-V shunts which bypass the capillary bed
B) Blood flow during erection
   i) Depends upon:
      a) Preferential filling of sinusoidal spaces
      b) Venous drainage
   ii) Caused by:
      a) An increase of arterial inflow by five-fold to six-fold without any change in systemic pressure
      b) Concomitant decrease in corporal vascular resistance (A-V shunts)
      c) Relative decrease in venous outflow mainly due to passive venoconstriction (veno-occlusive mechanism)
C) Neurophysiology
   i) Erection is due to activation of the parasympathetic inflow to the penis and inhibition of the sympathetic tone responsible for the contraction of corporal smooth muscle cells.
   ii) Erection is mainly under nonadrenergic, noncholinergic control and nitric oxide is considered to be the major neurotransmitter.
   iii) Cortical control via auditory, visual, tactile, and olfactory pathways
   iv) Sensory afferent—almost exclusively pudendal nerve
   v) Few parasympathetic, cholinergic, and purinergic, an abundance of adrenergic nerve fibers present in the corpora cavernosa and corpus spongiosum
   vi) Few cholinergic and some purinergic and/or peptidergic vesicles

Evaluation of Erectile Function

A) History and physical
   i) Age, marital status, sexual experience, performance anxiety, medical history, surgical history, medications including any phosphodiesterase type 5 inhibitor (PDE5), environmental issues, aphrodisiacs, recreational or other drug usage, stress, smoking and drinking profile, penile trauma, Peyronie's disease history, etc. [7–9]
   ii) Erectile function scoring—IIEF or similar questionnaires [4]
B) Blood work—hormonal profile (testosterone), glucose, and lipid profile (should the clinical findings suggest then include thyroid stimulating hormone [TSH] and prolactin)