

Original Article

Diagnostic Value of Penile Color Doppler Ultrasonography in Patients with Veno-occlusive Erectile Dysfunction

A Soylu, M Sarier¹, R Kutlu²

Department of Urology,
Gözde Academy Hospital,
Malatya, ¹Department
of Urology, Medical
Park Hospital, Antalya,
²Department of Radiology,
Medical Faculty, İnönü
University, Malatya, Turkey

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ABSTRACT

Background: The method used in the first assessment of patients with veno-occlusive erectile dysfunction (ED) is penile color doppler ultrasonography (PCDU). However, cavernosography performed following intracavernosal pharmacostimulation is accepted as a more precise method for showing venous leakage. **Aims:** The objectives of this study were to compare results obtained from patients undergoing PCDU, and those undergoing cavernosography, and to investigate the diagnostic value of PCDU in the diagnosis. **Methods:** A total of 133 patients who presented at the urology clinic due to ED have veno-occlusive dysfunction (VOD) detected as a result of PCDU and underwent cavernosography for further assessment when scheduled for penile embolization. The results obtained were retrospectively evaluated. **Results:** The mean age of 133 patients with VOD identified as a result of PCDU was 48.7 ± 11.2 years. In cavernosography performed after PCDU, venous leakage was detected in 127 patients (95.49%), while no leakage was found in six patients (4.51%). Bilateral venous leakage was found in 91.34% (n:116), right venous leakage in 5.51% (n:7), and left venous leakage in 3.15% (n:4) of the patients with venous leakage. **Conclusion:** Evaluating the cavernosography results, PCDU alone is often sufficient to diagnose veno-occlusive ED. Cavernosography is a more invasive diagnostic method compared to PCDU that is adequate in cases where venous surgery or embolization is not considered, and cavernosography is not recommended in these patients.

KEYWORDS: Cavernosography, erectile dysfunction, penil color doppler ultrasonography, veno-occlusive dysfunction

INTRODUCTION

A compatible interaction among vascular, neurological, hormonal, and psychological systems is necessary for healthy sexual function in men. The first essential event for male sexual activity is the occurrence and continuity of penile erection.^[1] Erectile dysfunction (ED) is defined as the inability to obtain and maintain a sufficient erection for a satisfactory sexual performance.^[2] The etiology of ED has been mainly classified as organic, psychogenic, and mixed.^[3] Organic-origin ED is divided into six subgroups: neurogenic, hormonal, vascular, anatomic, trauma-related, and drug-related and accounts for 80% of all causes of ED.^[4-7] Vascular-origin ED is the major cause of organic-origin EDs, and endothelial

dysfunction is the most important physiopathology. Vascular-origin EDs are evaluated as arterial insufficiency and veno-occlusive dysfunction (VOD). The veno-occlusive mechanism, which is one of the most important stages of penile tumescence, depends on the balance between the smooth muscle and connective tissue in the corpus cavernosum.^[8] Penile color doppler ultrasonography (PCDU) provides insight into the arterial and venous hemodynamic condition of

Address for correspondence: Dr. A Soylu,
Department of Urology, Gözde Academy Hospital, Malatya,
Turkey.
E-mail: drsoylu@yahoo.com

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the penis,^[9] and this is the first step of the evaluation of vascular pathologies in patients with ED. In patients suspected to have VOD with PCDU, dynamic infusion cavernosometry and cavernosography performed following intracavernosal pharmaco-stimulation are accepted as effective methods in showing venous leakage precisely.^[10] Although combined use of these two methods raises the probability of diagnosis, both methods can also be used alone. The objective of this study was to investigate the sufficiency of PCDU and the additional contribution of cavernosography to the diagnosis of ED due to VOD.

SUBJECTS AND METHODS

Patients who presented to the urology outpatient clinic of Turgut Özal Medical Center due to ED were found to have organic-origin ED, with VOD discovered via PCDU. The 133 patients who did not benefit from oral phosphodiesterase type-5 inhibitors were scheduled for deep dorsal vein embolization with n-butyl-2-cyanoacrylate and lipidol mixture^[11] and underwent cavernosography for the evaluation of venous leakage retrospectively. In the PRDU, penile grayscale ultrasonography was performed following the injection of 60 mg papaverine to a single body, and penile color and spectral doppler ultrasonography examinations were performed with a linear probe at an appropriate angle of a 30- to 60-degree sample interval from the proximal areas close to the radix level from the cavernous arteries (HDI 5000; Philips Medical Systems, Bothell, WA, USA, and LOGIQ 6; General Electric Medical System, Milwaukee, WI, USA). Grayscale ultrasonography findings and spectral Doppler findings including peak systolic velocity (PSV) and end diastolic velocity (EDV) were recorded by using 12/5 MHz linear probes. A value higher than 30 cm/s was accepted as arterial sufficiency. In terms of VOD, veno-occlusive sufficiency was considered when EDV values were obtained under baseline or when the EDV value dropped below 1 cm/s at the 20th minute. In the cavernosography, with the patient in the supine position following intracavernosal pharmacostimulation, low-osmolality contrast medium diluted 1:4 with saline solution was given intracavernously with a 19-gauge needle until erection over 90° was achieved. After a rigid erection was achieved, images were taken under fluoroscopy. Any venous leakage was measured. The study was approved by the local ethics committee (approval no: 2020/002) and the protocol conformed to the ethical guidelines of the 1975 Helsinki Declaration. All statistical analyses were performed using the SPSS statistical software (SPSS for Windows version 16.0 SPSS Inc. Chicago, IL, USA). Continuous variables were presented as mean \pm standard deviation.

RESULTS

The mean age of 133 patients with the presumed diagnosis of ED, and who were considered to have VOD with PCDU, was calculated as 48.7 ± 11.2 (28 to 70) years. According to the results of PCDU, the mean right PSV was 55.3 ± 21.2 cm/s, and the mean left PSV was 54.3 ± 20.3 cm/s. The mean right EDV was 8.3 ± 5.1 cm/s, and the mean left EDV was 7.7 ± 4.9 cm/s. The cavernosography results showed venous leakage of 95.49% (n:127) of the 133 patients, while no leakage was found in only 4.51% (n:6) of the patients [Figure 1d]. Of the 127 patients with venous leakage, bilateral venous leakage was found in 91.34% (n:116) [Figure 1a], right venous leakage in 5.51% (n:7) [Figure 1b], and left venous leakage in 3.15% (n:4) [Figure 1c].

DISCUSSION

The most seen sexual dysfunction in men is ED, which causes insufficient satisfaction in both sexual partners. This is a pathology that negatively impacts couples: self-esteem of the male, social relationships, and creates severe psychological problems.^[12] Although ED may occur at a younger age, it is most frequently seen in middle-age and elderly men.^[13] Epidemiological studies for the prevalence of ED have showed different results in different countries. In a study from Germany, the prevalence of ED in the 30–80 age group was 19%,^[14] while the prevalence of ED in the 18–75 age group was 26% in a study from England.^[15] Different prevalence values resulted from the difference between the methods used in these studies. On the other hand, in a study conducted in eight countries with more than 27,000 men, between 20 and 75 years, the prevalence of general ED was 16%; 8% between 20 and 30 years old; and 7% between 70 and 75 years old.^[16]

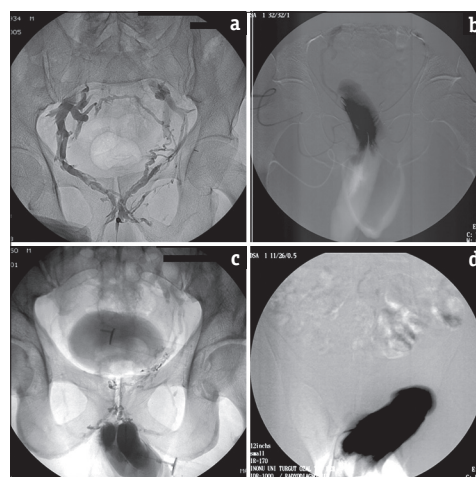


Figure 1: Cavernosography findings. (a) Bilateral venous leakage, (b) right venous leakage, (c) left venous leakage, and (d) no venous leakage

The most common etiology of organic ED is vasculogenic ED. ED can be a sign of various underlying vascular disorders. Endothelial dysfunction plays an important role in the pathophysiology of vasculogenic causes of ED. It commonly occurs as a result of insufficient synthesis, release, and response of endothelial NO.^[17] Hypercholesterolemia, hypertension, diabetes mellitus, smoking, and endothelial dysfunction due to aging are risk factors for ED because they cause arterial insufficiency.^[18] In VOD, hypoxia caused by decreased corpora cavernosal oxygenation may reduce the levels of prostaglandin E1, which normally inhibits profibrotic cytokines that promote collagen deposition, replacing the smooth muscle and resulting in decreased elasticity of the penis.^[19] Since the ratio of smooth muscle to collagen decreases and collagen content increases, the ability of the cavernosa to compress the subtunical veins decreases, causing corporal VOD.^[20]

Penil color doppler ultrasonography is an important part of the evaluation of patients with vasculogenic ED. It provides basal assessment of functional anatomy and real-time measurement of the dynamic changes in response to vasoactive medication.^[9] PCDU is an objective and minimally invasive evaluation of penile hemodynamics at low cost. The indications for vascular assessment and imaging may include (a) veno-occlusive disorder, (b) arterial/arteriolar arteriogenic dysfunction, (c) high-flow priapism, (d) Peyronie's disease, (e) penile trauma (such as a fracture), and (f) patients without symptomatic peripheral vascular disease who present with ED and undergo penile doppler to evaluate the risk of cardiovascular disease and the need for further peripheral vascular or cardiac assessment. Oral or intracavernosal vasoactive agents such as papaverine, either alone or in combination with phentolamine and prostaglandin PGE1, can be used to perform PCDU.^[21] A variety of methods can be used to stimulate blood flow to the penis and to create an erection in tests. In some instances, due to the subjectivity of observers assessing vasculogenic causes of ED precisely, interpreting the results of PCDU can be challenging. These difficulties include the gray area of determining the criteria to identify arteriogenic ED. Typically, it is the parameter of peak systolic blood flow in the penile arteries that is used to define arteriogenic ED. A normal peak flow rate is >35 cm/s, while an abnormally low peak flow is defined as <25 cm/s; the gray area are the values that fall between 25 and 35 cm/s.^[22] A second difficulty is the ambiguity of the criteria for diagnosing VOD. When the penis is fully erected, the EDV of the cavernosal arteries ought to be zero because of the increased intracavernosal pressure in the rigid stage of erection, reverse flow may also be observed. The usual parameter to diagnose VOD in men with veno-occlusive ED is an EDV >5 cm/s.^[23]

Peak systolic velocity is also a valuable parameter in patients with VOD. In PCDU performed following vasoactive medication, since a sufficient intracavernosal pressure cannot be produced in patients with arterial insufficiency, the venous occlusive mechanism will not completely function, which may cause false positive results. In the present study, the mean PSV values found in PCDU were highly significant. The mean right PSV value of 55.3 ± 21.2 cm/s and the mean left PSV value of 54.3 ± 20.3 cm/s show cases where we ruled out arterial insufficiency. Therefore, the inability to evaluate VOD because of arterial insufficiency was eliminated.

Dynamic pharmaco-cavernosometry and cavernosography have been employed the most and can additionally evaluate the venous occlusion function and the arterial inflow to the corpus cavernosum.^[24] In cavernosometry, isotonic saline is infused into the cavernous bodies, and intracavernosal pressure changes are monitored with or without vasoactive medication.

In cavernosography, an iodized contrast agent is injected into the corpus cavernosum with pressures that produce erection. Therefore, dynamic cavernosometry and cavernosography techniques give much more specific results. The contrast agent injection rate should create an intracavernous pressure of 90–100 mmHg. Since injection pressures lower than these values are not sufficient to activate the veno-occlusive mechanism as in PCDU, a continuous leakage will be monitored. In practice, injection of the contrast agent in an amount to produce suprapubic erection in the supine position in cavernosography can reach the desired intracavernous pressures without the need for cavernosometry. Finding the location of venous collaterals with cavernosography can determine the need for a venous surgical operation, which will be considered for eligible patients in the future.^[25]

According to our information, this is the largest study in the literature showing positive predictive value of PCDU in ED cases with VOD. The results of cavernosography in VOD cases are highly compatible with PCDU, such as 95.49%, so it will be valuable in postoperative success in patients who are considered to have surgery such as dorsal vein embolization. However, considering the results of cavernosography, bilateral venous leakage in 91.34% of VOD cases reveals the need for bilateral approach to venous structures in patients who are planned for surgery.

This study has some limitations. First, cavernosometry could not be performed together with cavernosography. Therefore, intracavernosal pressures could not be monitored. Intracavernosal pressure sufficient for

the determination of VOD was accepted because a suprapubic rigid erection resulted from the contrast agent given during the cavernosography. Second, the sensitivity and specificity of PCDU in VOD cases could have been calculated by performing cavernosography in ED patients with normal PCDU results. But cavernosography was not performed because it would be unethical as it is an invasive procedure.

CONCLUSION

In our study, according to the results obtained from cavernosography, the diagnosis was correctly established in more than 95% of the patients who were found to have VOD with PCDU. This result indicates that PCDU is highly sufficient in the diagnosis of veno-occlusive ED. Cavernosography is a more invasive diagnostic method than PCDU. PCDU is recommended in cases where venous surgery or embolization is not considered, whereas cavernosography is not recommended for these patients.

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Conflicts of interest

There are no conflicts of interest.

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