

## Original Article

# Dynamic and Morphologic Evaluation of Erectile Dysfunction on Penile Doppler Sonography and Contrast Cavernosography

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ABSTRACT

**Background:** Penile erection is a complex phenomenon that involves coordinated interaction of the psychologic, hormonal, nervous, arterial, venous, and sinusoidal systems. Erectile dysfunction (ED) is the persistent inability to attain or maintain penile erection sufficient for sexual intercourse. This study aims to determine the real-time morphologic vascular abnormalities in men with ED using penile Doppler sonography in Kano, Nigeria. **Materials and Methods:** Twenty-one patients who were referred from urology clinics on account of suspected vasculogenic ED were reviewed. The cavernosal arteries were examined with 7.5 MHz linear transducer in gray scale and duplex Doppler modes before and after intracavernosal injection of 60 mg papaverine. Serial peak systolic velocity (PSV), end diastolic velocity (EDV), and diameter measurements were performed at 5-min intervals for 30 min. **Results:** The mean age of the patients was  $43.14 \pm 9.84$  years. Out of the 21 patients examined, 5 showed normal findings while 10 had evidence of venous leakage. Five patients had arterial insufficiency; out of which 3 patients showed calcifications of the tunica albuginea, suggesting Peyronie's disease. Interestingly, 1 patient showed combining features of arterial insufficiency and of venous leakage. Those with arterial insufficiency were relatively older than other patients. They also had compounding medical conditions of diabetes and hypertension. **Conclusion:** Vascular etiologies are important contributors of ED in our setting. Papaverine-induced Doppler sonography and cavernosography shows promise in accurate assessment and overall care of these patients.

**KEYWORDS:** Cavernosography, Doppler scan, erectile dysfunction, papaverine, vasculogenic impotence

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## INTRODUCTION

Penile erection is complex process which results from coordinated interaction of the psychologic, hormonal, nervous, arterial, venous, and sinusoidal systems. Erectile dysfunction (ED) is the persistent inability to attain or maintain penile erection sufficient for sexual intercourse.<sup>[1]</sup> The majority of cases have an organic etiology, most commonly vascular disease that decreases blood flow into or allow early venous leakage from the penis.<sup>[1]</sup> Regardless of the primary cause, erectile dysfunction can have a negative impact on self-esteem, quality of life, and interpersonal relationships.<sup>[1,2]</sup> The estimated global prevalence has projected that the number of men with ED will rise to 322 million by the year 2025.<sup>[2]</sup>

Erectile dysfunction is usually underestimated in Nigeria because it is not a life threatening condition, and due to

associated stigma men with the problem rarely seek help.<sup>[2]</sup> The reported prevalence of ED in Nigeria varies 26.4–46.9% taking the multifactorial etiologic factors into consideration.<sup>[2,3]</sup> However, the frequency of vascular abnormalities in ED patients is unknown in our setting. Therefore, it would be of benefit to routinely evaluate the penis vasculature in all patients who at least do not present with an obvious nonvascular cause of ED.<sup>[4]</sup>

The approach to the investigation of vasculogenic impotence includes the use of one or a combination of dynamic infusion cavernosometry and cavernosography (DICC), Doppler sonography, internal pudendal

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angiography, penile venography, and scintigraphy. The infusion component of DICC and arteriography are too invasive, whereas scintigraphy is not widely available. Hence, for hemodynamic and morphologic assessment, this study combines the use of penile Doppler sonography and cavernosography (PDSC) to determine the pattern of vasculogenic ED in Kano, Nigeria.

### MATERIALS AND METHODS

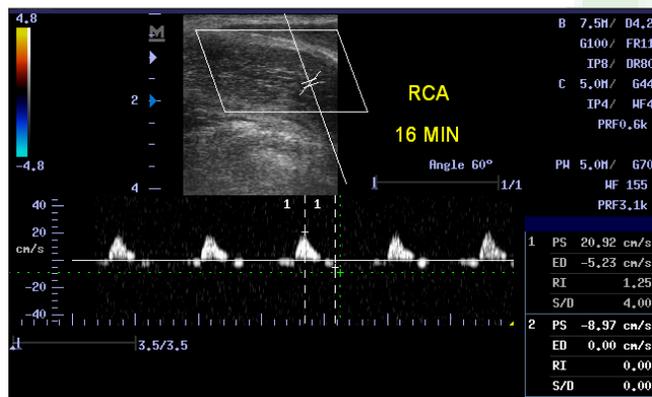
Twenty-one patients who were referred from urology clinics on account of suspected vasculogenic erectile dysfunction within an 18-month period (from October 2013 to March 2015) were reviewed. The cavernosal arteries were examined with 7.5 MHz linear transducer in gray scale and duplex Doppler modes before and after intracavernosal injection of vasodilator (60 mg papevarine). Serial peak systolic velocity (PSV), end diastolic velocity (EDV), and diameter measurements at 2, 5, 10, 15, 20, 25, and 30 min were obtained. A PSV of less than 25 cm/s was considered to be the threshold for arterial insufficiency [Figure 1].<sup>[5]</sup> An EDV of  $\geq 5$  cm/s 15 min post injection was used to predict venous incompetence [Figure 2].<sup>[5]</sup> Contrast

cavernosography was obtained following the preliminary film and intracavernosal injection of contrast medium and papevarine [Figure 3].

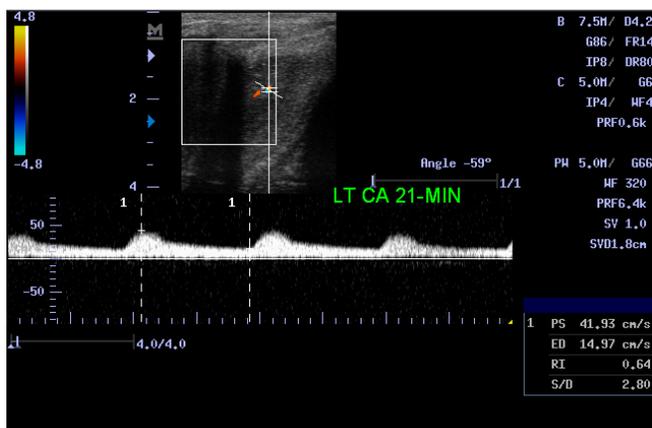
### RESULTS

The age of the patients ranged from 25 to 60 years with a mean of  $43.14 \pm 9.84$  years. Almost all patients showed significant increase in cavernosal artery diameter within the first 5 min post injection of papevarine. As shown in [Table 1], 10 patients had venous leakage, constituting 47.6% of the study population. These patients never sustained rigid erection, which rapidly collapsed to the flaccid state until the disappearance of the effects of papevarine. On Doppler analysis, they showed high EDV ( $\geq 5$  cm/s) 15 minutes post injection, and majority (75%) showed evidence of opacification of the penile and pelvic veins on contrast cavernosograms [Figure 4]. Furthermore, one of the patients showed alternating wave form of the cavernosal arteries due to cardiac arrhythmia.

Five patients had arterial insufficiency (23.8%). These patients never achieved rigid erection during the course of the examination and remained in a flaccid state until the resolution of the effects of papevarine. On sonography, these patients showed minimal increase in



**Figure 1:** Doppler sonogram of the right cavernosal artery 16 min post injection of papevarine, showing a PSV of 20.92 cm/s



**Figure 2:** Doppler sonogram of the left cavernosal artery 21-min post injection of papevarine, showing a persistently elevated EDV (14.32 cm/s)

**Table 1: Showed the distribution of the findings on the cavernosograms. ART + VENOUS DZ**

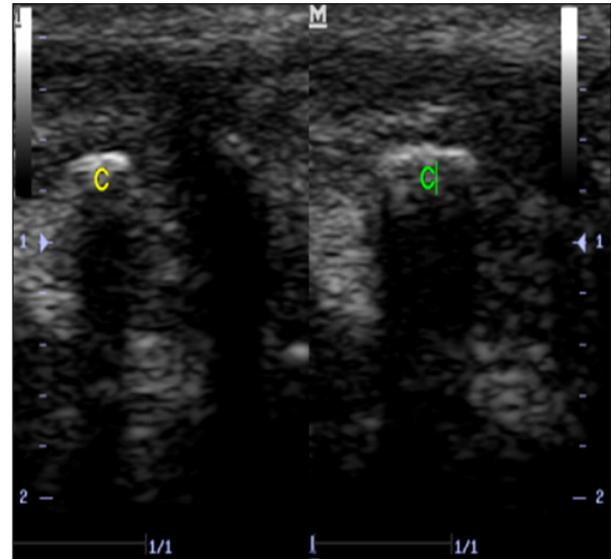
Diagnosis	Frequency	Percentage
Arterial + venous disease	1	4.76
Arterial insufficiency	4	19.05
Venous leakage	10	47.62
Normal	6	28.57
Total	21	100



**Figure 3:** Contrast cavernosography showing a fairly uniform opacification of the cavernosal tissues



**Figure 4:** Contrast cavernosogram, in a patient with ED secondary to venous leakage. It shows opacification of the dorsal and left cavernosal veins



**Figure 5:** A transverse sonogram at the root of the penis showing calcifications of the tunica albuginea in a patient, suggesting a likelihood of Peyronie's disease

**Table 2: Age-descriptive statistics of the findings at cavernosography**

Diagnosis (N)	Mean age (YRS)	SD	Minimum	Maximum
Normal (5)	44.67	10.07	34.00	57.00
Arterial Insufficiency (5)	45.75	9.64	39.00	60.00
Venous Leakage (10)	40.10	9.99	25.00	50.00
Arterial Dz + Venous Leak (1)	54.00	NIL	54.00	54.00

diameter of the cavernosal artery compared to those with venous leakage. In addition, the PSV of their cavernosal arteries never reached 25 cm/s throughout the period of the examination. Out of these 5 patients with arterial insufficiency, 3 patients showed calcifications of the tunica albuginea on gray-scale ultrasound, which suggest a likelihood of Peyronie's disease [Figure 5].

On the other hand, 5 patients showed normal findings, constituting 23.8% of the study population. Interestingly, one of the patients showed combining features of arterial insufficiency and that of venous leakage. This index case showed a maximum PSV of 22 cm/s in the cavernosal arteries and EDV of 5.2 cm/s at approximately 16 min of the examination. Thus, suggesting a mixed pattern of vasculogenic impotence.

Table 2 shows the age summarizing the indices of the different diagnostic groups of the study population. Those with arterial insufficiency were relatively older than those with venous leakage and those with normal cavernosograms. Although these differences were not statistically significant, approximately 4 patients with arterial insufficiency also had compounding medical conditions of diabetes and hypertension, whereas only 1 patient with venous leakage had hypertension.

## DISCUSSION

Doppler evaluation in erectile dysfunction (ED) has a significant role in determining the cause of ED.<sup>[4-6]</sup> The advantages of penile Doppler and pharmacologic duplex ultrasonography include being objective and minimally invasive evaluation of penile hemodynamics at a relatively low cost. According to Quam *et al.*,<sup>[7]</sup> DICC is comparable to other invasive techniques such as cavernosometry and pelvic arteriography. They found 6 of the 7 patients with normal arteriography had mean peak systolic velocities of greater than 25 cm/s (specificity = 85.7%; 95% confidence interval = 42–100%) after injection of papaverine. They also found that the EDV in the cavernosal arteries of greater than or equal to 5 cm/s after the injection of papaverine correctly identified patients with excessive venous leakage on cavernosometry; the sensitivity was 90% (95% confidence interval = 77–97%) and the specificity was 56% (95% confidence interval = 30–80%).<sup>[7]</sup>

In general, Doppler ultrasound has been successfully used to document veno-occlusive dysfunction in some patients. It has shown good correlation between EDV of the cavernosal arteries and the presence of venous leakage. In the normal erectile response, there should

be little (<5 cm/s) if any detectable flow within the cavernosal arteries during the diastolic phase 15–20 min after intracavernous injection and self-stimulation.<sup>[5-8]</sup>

This review of 21 patients with ED showed a mean age of  $43.14 \pm 9.84$  years. This is in agreement with the review of Clifford and Toppo<sup>[9]</sup> that included 50 patients with ED; they found a mean age of 40.83 years. Bari *et al.*<sup>[10]</sup> also recorded a similar mean age (of  $41 \pm 12.25$  years) from Pakistan. However, a slightly older age (of 51.7 years) was documented by Mulhall *et al.*<sup>[11]</sup> among 49 patients when they attempted to define the prevalence and identify predictors of occult coronary artery disease in patients with vasculogenic ED. Similarly, in their review of 220 patients with ED, Serefoglu *et al.*<sup>[12]</sup> reported a mean age of  $55.0 \pm 9.2$  years. On the other hand, McMahon<sup>[13]</sup> recorded a much older mean age (63.1 years) in his attempt to standardize the pharmacological diagnostic screening of vasculogenic impotence with prostaglandin E-1 among 283 men. Nevertheless, these differences could be from variations in life expectancies and in sample sizes of the studies.

Majority of our participants (76.2%) showed variety of abnormalities on cavernosograms whereas 23.8% had normal cavernosograms. Clifford and Toppo<sup>[9]</sup> also showed a high prevalence of vasculogenic ED (54%) whereas 46% had normal findings. In the same vein, a review of 220 patients by Serefoglu *et al.*<sup>[11]</sup> showed that 69.5% of their participants had abnormal cavernosograms whereas 30.5% were normal. However, this is at variance with the findings of a Greek study conducted among 67 patients with moderate-to-severe ED by Vakalopoulos *et al.*<sup>[4]</sup> Only 33.3% of their patients showed abnormalities of either arterial insufficiency or venous leakage whereas 66.7% had normal findings. Similar to the Greek study, Bari *et al.*<sup>[10]</sup> also found the prevalence of vasculogenic impotence at 33% on 70 cavernosograms in Pakistan.

Among patients with abnormalities on cavernosograms, there was predominance of venous disease (constituting 47.6%). Arterial insufficiency constituted 23.8% whereas 4.8% presented with a combined arterial and venous disease. Though there are differences in the relative frequencies of the arterial and combined abnormalities (arterial and venous disease), our findings in respect of venous disease corroborate those of Serefoglu *et al.*<sup>[12]</sup> from their study in an American population; they found a prevalence of arterial insufficiency at 10%, venous disease of 43.2%, while combined disease of 16.4%. On the contrary, Bari *et al.*<sup>[10]</sup> reported near-equal prevalence of arterial insufficiency (12/70) and (11/70) venous leak among the 70 cases reviewed. On the other hand, a Turkish study involving 32 patients with ED by Yavas *et al.*<sup>[14]</sup> showed high preponderance of arterial insufficiency

(50%) compared to those with venous incompetence (25%).

In this study, the mean age of those with venous leakage was 41.10 years. This is lower than 30.6 years recorded by Tang *et al.*<sup>[15]</sup> (in their study on 358 patients with ED) but lower than the mean of 56 years documented by Vale *et al.*<sup>[16]</sup> in their review of long-term results of patients after surgery for the management of ED caused by venous leakage. A closer look at those with arterial insufficiency showed a relatively older mean age (45.75 years). This may be attributable to the high frequency of medical conditions and risk factors for cardiovascular diseases. As shown in these patients, almost all cases of hypertension and diabetes were found in this group of patients with ED in our series.

Vasculogenic causes are important causes of erectile dysfunction, and papavarine-induced Doppler sonography and cavernosography are promising and accurate tools for assessing these patients.

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Nil.

### Conflict of Interest

There are no conflicts of interest.

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