

# Colour Doppler Sonography of Flaccid Penis in Evaluation of Erectile Dysfunction

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**BACKGROUND:** Erectile dysfunction is a common and potentially treatable problem. Other than psychological, anatomical and metabolic factors, vasculogenic causes also play an important role in erectile dysfunction. Among the various diagnostic tools available for the diagnosis of vasculogenic causes, colour Doppler sonography is noninvasive, simple and promising.

**METHODS:** This preliminary prospective study was conducted on 40 patients with erectile dysfunction, coming from a rural background to a hospital situated in a semi-urban setting.

**RESULTS:** It was found that a cut-off value of 10 cm/second for peak systolic velocity in flaccid penis had the best accuracy among three chosen cut-off values, i.e. 5, 10, 15 cm/second, for detecting arterial insufficiency with sensitivity of 94.1%, specificity of 93.6%, negative predictive value of 98% and positive predictive value of 80%.

**CONCLUSION:** Doppler sonography may be used as a good predictor of clinical response to intracavernosal injection of a vasodilating pharmacological agent. [*Asian J Surg* 2007;30(2):122-5]

**Key Words:** erectile dysfunction, sonography

## Introduction

Erectile dysfunction is defined as the inability of a male to obtain and/or maintain erection sufficient for vaginal penetration.<sup>1</sup> Although psychological factors play an important role, vasculogenic impotence is one of the most important cause of erectile dysfunction that can be arteriogenic, venogenic or both.<sup>2</sup> The psychomatic and neurological pathways that normally initiate erection are by passed by injecting vasodilators intracavernosally, hence this technique is used as a screening test for evaluation of impotence. However it fails to differentiate arteriogenic from venogenic impotence which is important as the treatment of both types is markedly different.<sup>3</sup> Colour Doppler sonography of the cavernosal arteries with intracavernosal injection (ICI) of vasoactive agent has been

widely used to evaluate impotence as it differentiates between arteriogenic and venogenic impotence.

This study was undertaken to correlate peak systolic velocity (PSV) on colour Doppler in flaccid penis and after giving intracavernosal injection of papeverine with erectile response to assess the potential value of PSV in the flaccid penis for diagnosing arterial insufficiency.

## Materials and methods

In this preliminary study, 40 consecutive patients referred from the departments of urology and psychiatry who gave their consent to enter the study and only those with history of erectile dysfunction of at least 6 months duration were included. After a detailed history, physical and clinical examination of the penis, detailed psychological evaluation

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was carried out in all patients. Laboratory investigations were performed that included haemoglobin leucocyte count and red blood cell morphology in peripheral blood film, erythrocyte sedimentation rate, blood sugar, blood urea and urine examination. All these patients had tried phosphodiesterase-5 inhibitors and the response was variable but generally unsatisfactory, forcing them to seek further medical advice. Sonography was done using a high frequency wide band 6–13 MHz linear array transducer in a quiet, isolated comfortable room to ensure privacy of patients. Echotexture of the penis was evaluated in longitudinal and transverse planes on grayscale. Colour Doppler sonography was performed in penis in flaccid state and after intracavernosal injection of papaverine up to 30 minutes (60 mg [2 mL] papaverine diluted with 3 mL of normal saline was injected using 26G needle). Bilateral cavernosal arterial diameters and PSVs were measured in both flaccid and post-ICI states. The clinical response to intracavernosal injection was also evaluated. The response was classified as normal (tumescence with rigidity sufficient for intercourse) or abnormal (tumescence with rigidity insufficient for intercourse). All the patients were retained in the ward for 3 hours to check for any complications after the injection. Three different cut-off values for lowest normal PSV before injection, 5 cm/second, 10 cm/second and 15 cm/second, were tested.

## Results

Forty consecutive patients between 21 and 55 years of age comprising seven patients in their 3<sup>rd</sup> decade of life, 14 in 4<sup>th</sup>, 12 in 5<sup>th</sup> and seven in 6<sup>th</sup> decade were included in the study. Clinicopsychological evaluation was suggestive of psychological causes in 27 patients affecting performance due to anxiety, depression, sexual inhibition, stress, neurosis and marriage problems. Organic cause was suspected in five patients with history of perineal trauma, three patients with diabetes and hypertension, and one patient each with isolated Peyronie's disease and hypertension. In three patients, both organic and psychological abnormalities were detected. Of these, one patient was suffering from diabetes mellitus, hypertension and depression, and one patient each had depression, stress and hypertension.

Spectral waveforms were recorded from cavernosal arteries (80 in number) before and post-ICI of papaverine. The PSV varied between 4.1 cm/second and 18.5 cm/second in flaccid state while post-ICI of papaverine PSV

varied between 10.4 cm/second and 74.8 cm/second in the cavernosal arteries. Abnormal clinical response was seen in nine patients (22.5%), post-ICI of papaverine. PSV in B/L cavernosal arteries was > 25 cm/second in all patients with normal clinical response, while PSV was < 25 cm/second in all patients with abnormal clinical response, except in one case who had PSV of 25.2 cm/second and 19.1 cm/second in the left and right cavernosal arteries respectively. Post-ICI mean PSV was 39.3 cm/second and 19.75 cm/second in patients with normal and abnormal clinical response, respectively. Similarly in flaccid state, mean PSV with normal response was 12.91 cm/second while it was 6.79 cm/second with abnormal clinical response, which was a statistically significant difference ( $p < 0.04$ ). Grayscale sonography was normal in all cases except in one with Peyronie's disease where dense echogenic areas with post acoustic shadowing were seen in corporeal parenchyma and intercorporeal septum suggestive of calcified plaques on sonography. All the 27 patients with only psychological abnormalities showed normal response to papeverine injection. Normal response was seen in two patients with history of perineal trauma and one patient each with Peyronie's disease and hypertension with stress. All the four patients with diabetes with hypertension including the one suffering from depression showed abnormal response. Abnormal response was also seen in three patients with history of trauma and two patients with hypertension, one having depression also. On colour duplex sonography, mean diameters of cavernosal arteries in flaccid state were 0.56 mm and 0.59 mm and post-ICI 1.02 and 1.05 in the right and left side, respectively.

Complication in the form of persistent erection (priapism) was seen in three patients only. Around 20 mL of blood was withdrawn from both corpora cavernosa of all three patients with a 16G needle and the priapism subsided without any further complications.

We found that the cut-off value of 10 cm/second for PSV in flaccid state had the best accuracy among the three chosen cut-off values with sensitivity of 94.1%, specificity of 93.6%, negative predictive value of 98%, and positive predictive value of 80% (Table). Twenty-nine patients with normal clinical response had PSV of 10 cm/second or more in flaccid state. Eight patients with abnormal clinical response had bilateral PSV ranging from 4.1 to 9.4 cm/second in flaccid state. There was only one false-positive case where with normal clinical response, bilateral PSV in flaccid state was low (right side, 9.1 cm/second; left

**Table.** Comparison between pre-ICI and post-ICI PSV values using various thresholds for lowest normal pre-ICI PSV and their statistical values

Peak ICI threshold and values	No. of patients by post-ICI PSV				Sensitivity (%)	Specificity (%)	Negative predictive value (%)	Positive predictive value (%)
	Right cavernosal artery		Left cavernosal artery					
	≥ 25 cm/sec*	< 25 cm/sec	≥ 25 cm/sec*	< 25 cm/sec				
5 cm/sec threshold					23.5	100	83	100
< 5 cm/sec	0	2	0	2				
≥ 5 cm/sec	31	7	32	6				
10 cm/sec threshold					94.1	93.6	98	80
< 10 cm/sec	1	8	3	8				
≥ 10 cm/sec	30	1	29	0				
15 cm/sec threshold					100	19	100	25
< 15 cm/sec	26	9	25	8				
≥ 15 cm/sec	5	0	7	0				

\*A post-ICI PSV > 25 cm/sec was considered normal. ICI = intracavernous injection; PSV = peak systolic velocity.

side, 9.7 cm/second) and normal PSV post-ICI (right side, 28.1 cm/second; left side, 27.7 cm/second). The only false-negative case had PSV of 10.9 cm/second and 10.7 cm/second in flaccid state in right and left side respectively and post-ICI PSV of right side, 19.1 cm/second, and left side, 25.2 cm, with abnormal clinical response.

### Discussion

The present study was performed in a hospital situated in a semi-urban setting of India with poor literacy where growing awareness has resulted in the addition of modern imaging investigative modalities. Laboratory facilities are not advanced and facilities for hormonal (testosterone) assay do not exist.

The growing interest in sexual function and its disturbance has led an increasing number of patients with a variety of sexual problems to seek their doctors. Erectile dysfunction is a common and potentially treatable problem.<sup>4</sup> In the clinical evaluation of patients with erectile dysfunction, colour duplex Doppler sonography is widely used in conjunction with ICI of a vasoactive pharmacological agent to induce an erection. This study was undertaken to correlate PSV on colour Doppler in flaccid penis and after giving ICI of papaverine with clinical responses to assess the potential value of PSV in the flaccid penis for diagnosing arteriogenic insufficiency. Since this was a preliminary study and papeverine was injected only once, titration of the drug was not carried out and was deferred

for follow-up studies. Cavernosal arterial dilatation (>60%) after papaverine injection has been found not to correlate with the results of angiography by various studies because of difficulties in accurately evaluating the diameter of such small vessels.<sup>5,6</sup> So no correlation was made with changes in the diameter of cavernosal arteries. Our results are in agreement with those of other studies. The mean PSV of normal cavernosal arteries before ICI has been reported to be 11.2–20 cm/second in other studies by Schwartz et al<sup>7</sup> and Meuleman et al.<sup>5</sup> Impaired arterial supply due to arterial disease is expected to produce decreased blood flow velocities on spectral analysis and therefore, post-ICI PSV values have been used to identify arterial insufficiency in the penis. Post-ICI PSV of usually ≥ 25 cm/second was considered normal by various studies.<sup>2,8,9</sup> In our study, it was observed that 22.5% (9/40) of patients had abnormal clinical response post-ICI. Roy et al<sup>10</sup> observed that 29% (13/44) of patients had abnormal clinical response post-ICI. In our study, all the patients with normal clinical response had post-ICI PSV > 25 cm/second in bilateral cavernosal arteries. Most of the patients with abnormal clinical response had post-ICI PSV < 25 cm/second except one case who had post-ICI PSV of 25.2 cm/second on the left side. Our results are similar to those of various other studies.

Three patients (7.5%) in our study had prolonged erection (priapism). Other studies also reported complication of priapism like Quam et al<sup>2</sup> in three out of 180 patients and Mueller et al<sup>11</sup> in 52 of 472 patients. A minor degree

of asymmetry in PSV values between right and left side was observed in our study, which suggests that the overall blood supply is not equally shared between the two corpora cavernosa. Similar results were also reported by others.<sup>5,7,12</sup> Based on the observations, three cut-off values, 5, 10 and 15 cm/second, were chosen for the lowest normal PSV in flaccid state. Our observation has shown that the cut-off value of 10 cm/second of lowest PSV in flaccid state had best accuracy compared to 5 cm/second and 15 cm/second in the diagnosis of arteriogenic impotence. Our results were in agreement with other studies. Role of power Doppler imaging in evaluating the haemodynamics of penile arterial system in patients with erectile dysfunction has also been shown by Sakamoto et al<sup>13</sup> and Speel et al<sup>14</sup> in recent studies.

Thus, we conclude that a cut-off value of 10 cm/second for PSV of the cavernosal arteries on colour Doppler in the flaccid penis is sensitive in diagnosing arterial insufficiency, with a very high negative predictive value, and may be used as a predictor of clinical response to intracavernosal injection of a vasodilating pharmacological agent.

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