ABSTRACT: Color doppler sonography can be useful in the evaluation of erectile dysfunction, which can result from psychogenic, endocrinologic, neurogenic, pharmacologic, and vasogenic causes. OBJECTIVE: To assess the role of Color doppler sonography in the evaluation of erectile dysfunction. MATERIAL AND METHODS: A cross-sectional study of twelve men with erectile dysfunction (between the age group of 45-60 years) underwent penile color doppler sonography. The hemodynamic function of the penis was evaluated by power Doppler US with spectral analysis following injection of a vasoactive pharmacological agent, Papaverine, to induce an erection. RESULTS: Out of twelve patients, eight patients had normal Doppler sonographic findings; two had signs of veno-occlusive dysfunction and two had features of arterial insufficiency. CONCLUSION: Papaverine induced Color Duplex Doppler Sonography is an excellent and highly accurate means of assessing patients with erectile dysfunction. Even though arteriography is considered as the gold standard for assessing arteries of the penis, color doppler ultrasonography plays an important role in assessing erectile dysfunction due to arterial insufficiency and venous incompetence. KEYWORDS: Penile Doppler, Erectile Dysfunction, Penile Anatomy, Papaverine, Peak Systolic Velocity.
artery is at its maximum. In tumescent phase the sinusoidal cavities of the corpora cavernosa distends with blood. In full erection state, blood flow decreases along with decrease in the diameter of the cavernosal artery. In the rigid erection state blood flow ceases. Detumescence is due to arterial contraction which leads to the release of norepinephrine. Five stages shows five different diameter of the cavernosal artery as well as the wave pattern in the color doppler ultrasonography.

Lue et al. showed that precise Doppler sampling and blood velocity measurements of the deep cavernosal arteries could be performed before and after intracavernosal injection of vasodilating agents and 75% increase in vessel diameter is good indication of normal arterial flow into the cavernosal artery.¹

**MATERIAL AND METHODS:** Cross-sectional study oftwelvemen with complaints of erectile dysfunction (between the age group of 45-60 years) came for penile color Doppler sonography in the department of radiology at the Yenepoya Medical College was included in the study.

A brief history was taken and adequate privacy and quiet surrounding was provided to avoid patient anxiety as much as possible. A grey scale ultrasound was performed with patient lying supine position and the penis in the anatomical position. Imaging is performed both in the longitudinal as well as transverse sections of the penis to see corpora cavernosa, cavernosal arteries and adjacent structures to rule out fibrosis, scaring, calcification and tumors of the penis. Transducer is applied gently with minimal penile compression, followed by a baseline study of the cavernosal arteries and pre-injection velocities.

Intracavernosal injection of 60mg of papaverine with an insulin syringe close to the base of penis was given and massaged. Measurements of peak systolic and end-diastolic velocities were obtained in either cavernosal arteries at 5-min intervals for a total of 30 minutes. A peak systolic velocity of less than 25 cm/sec was used as the threshold for arterial insufficiency. An end-diastolic velocity of greater than 5 cm/sec was used to predict venous incompetence.¹

**RESULTS:** Out of twelve patients, eight patients had normal Doppler sonographic findings; two had signs of veno-occlusive dysfunction and two had features of arterial insufficiency. All the patients included in this study were between the age group of 45-60years.

Mean pre injection inner diameter of cavernosal artery was 0.5mm and post injection mean inner diameter was 1.0mm.

Out of these twelve patients, nine had complaints of diabetes mellitus and hypertension and are also under medication. Out of these nine patients, eight showed normal penile doppler sonographic findings with a mean peak systolic velocities of 30cm/sec and suggestive of psychogenic or medical causes leading to erectile dysfunction.

Two out of twelve patients showed features of arterial insufficiency with mean peak systolic velocities of 18cm/sec and other two patients showed evidence of venous incompetence with persistence of diastolic flow without reversal even at the end of 20min after injection of papaverine with a mean end diastolic flow of 6cm/sec. No evidence of peyronie's disease was seen in this study.

**DISCUSSION:** Erectile dysfunction (ED), the consistent inability to achieve and maintain an erection sufficient for satisfactory sexual function, results from organic disease in up to 80% of cases.² Most of these cases are the result of hemodynamic dysfunction, with arterial insufficiency (in up to 80%) or
venous incompetence. Various parameters, such as the diameter of the cavernosal artery, peak systolic flow velocity (PSV), degree of arterial dilatation, and acceleration time, have been suggested for the diagnosis of arteriogenic ED, but the PSV is the most accurate indicator of arterial disease.2

NORMAL DOPPLER FINDINGS: Before injection during the flaccid state systolic wave form is damped and monophasic with minimal diastolic component. After injection of papaverine, changes in the spectral wave form has to be correlated with flaccid, latent, tumescent, full and rigid state of erection. During the initial latent state there will be sudden increase in both systolic and diastolic flow in the cavernosal artery. When there is increase in the blood flow in the corpora cavernosa ,it will lead to the increase in intercavernosal artery pressure and small dicrotic notch appears at the end systole. During full erection phase flow reversal can be seen in the diastole and systolic wave forms appear narrowed. In the rigid phase of erection both systolic and diastolic flow may cease completely due to approaching of pressure in corporal bodies same as systolic blood pressure.

Patients with a PSV of greater than 25 cm/sec and diastolic flow reversal in the cavernosal arteries who reached well-sustained rigidity for at least 20 minutes were considered to have no abnormalities. Patients with a PSV of less than 25 cm/sec in the cavernosal arteries were considered to have arterial insufficiency.

There should be decrease and eventual absence or reversal in the normal spectral Doppler in the rigid erection phase. If there is veno-occlusive dysfunction then this decrease or reversal of the diastolic flow will not occur with end diastolic flow more than 5cm/sec, as in our study 2 Patients showed persistence in the end diastolic flow, with mean end diastolic flow of 6cm/sec.

Radiologic imaging in the field of ED has diminished in importance over the past 12 years with the introduction of new effective oral therapies and the recognition that surgical treatments of both penile venous leaks and arterial insufficiency have poor long-term clinical outcomes.2

CONCLUSION: Papaverine induced Color Duplex Doppler Sonography is an excellent and highly accurate means of assessing patients with erectile dysfunction. Even though arteriography is considered as the gold standard for assessing arteries of the penis color Doppler ultrasonography plays an important role in assessing erectile dysfunction due to arterial insufficiency and venous incompetence. It is also an effective method for differentiating psychogenic and vasogenic causes of erectile dysfunction.

REFERENCES:
Cross sectional US image of penis showing hyper echoic area in left corpus cavernosum due to papaverine injection

Cross sectional US image of the penis showing two Corpora cavernosa(1) and one corpus spongiosum(2)

Longitudinal US image post papaverine injection showing prominent cavernosal artery (9.5mm)
Color doppler US image of the penis in the normal rigid erection phase showing narrowed systolic peak with brisk velocity and diastolic reversal

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