Assessment of vasculogenic impotence in diabetic men: Using color Doppler flow sonography

Hasan ÖZCAN[1], İlhan ERDEN[1], Suat AYTAÇ[1], Nihat ARIKAN[2], Kemal SARICA[2], Hüseyin SÜMER[1],

Depts. of [1] Radiology and [2] Urology, Medical School of Ankara University, Ankara-TURKEY

We evaluated 26 male diabetics for sexual dysfuntion. We used color Doppler flow sonography to assess the hemodynamic function of the penis in patients with diabetes mellitus (DM) to detect the presence of arterial disease or venous incompetence. In addition, penile venous competence of all patients were also assessed with dynamic cavernosography/cavernosometry. Mean peak-systolic and end-diastolic velocities were measured for each cavernosal artery before and after the intracavernosal injection of papaverine. 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. Among the 26 patients with diabetes mellitus, 8 patients (30.70%) had venous leakage, 16 patients (61.53%) had arterial insufficiency and 2 patients (7.69%) had normal color Doppler flow ultrasonographic findings.[Turk J Med Res 1993; 11(3): 136-139]

Key Words: Impotence, Color Doppler imaging, Diabetes mellitus

Sexual dysfunction is a common complication of diabetes mellitus among male population. It is estimated that between 25 and 60 per cent of all diabetic men will have impotence of varying degrees at some stage of their sexual lives. Characteristically, erectile dysfunction develops 10-15 years earlier in diabetics than nondiabetics (1-3).

The cause of diabetic impotence has not yet been fully understood. There are contradictory reports about vascular, neurological, psycoblogical and endocrinological causes in the pathogenesis of this problem. Evidence of vascular etiology of diabetic impotence was reported by Herman (2). Moreover Jevtich reported that insufficiency of the penile arteries was the primary factor in impotent patients with diabetes mellitus (4).

Normal erection function requires norma! endocrine balance, psychiatric health, normal hemodynamic function and intact innervation of the penis. In the presence of erectile dysfunction, endocrinological and neurological abnormalities can be excluded easily by careful evaluation of medical history, physical examination and endocrine assays. Psychiatric causes can be ruled out by normal result of NPT (nocturnal penil tumescence) monitoring in patients with normal endocrine assays and normal neurological findings. The evaluation of hemodynamic factors requires more invasive analysis of arterial flow and venuos competence. Several indirect methods such as penile-brachial index, photoplethysmography, penile thermography and continuous wave Doppler sonography provide nonspesific values which can suggest hemodynamic dysfunction (5) but the value of these techniques in grading and location of the arterial insufficiency and also independent or simultaneous presence of venous incompotence cannot be determined. The intracavernosal injection of vasoactive agents (e.g, papaverine, phentolamine, prostaglandin E1) has been widely used to test the integrity of the penile vascular system since 1982. This procedure is easy to perform and is probably the best screening test for impotence of vascular origin. Although it cannot be used to differentiate arteriogenic impotence from that due to venous leakage.

Duplex sonography is an important addition to the diagnostic techniques available for the evaluation of Impotence. The combination of duplex and color Doppler sonography for the evaluation of cavernosal arterial flow velocity is a promising noninvasive method to examine patients with suspected vasculogenic impotence.

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Correspondence: Hasan ÖZCAN
Department of Radiology
Medical School of Ankara University
06100, Ankara-TURKEY

We used color flow Doppler sonography to assess the hemodynamic function of the penis in Impotent patients in order to determine the presence of arterial Insufficiency or venous Incompetence.

MATERIALS AND METHODS

Between May 1991 and June 1992, twenty-six impotent patients with diabetes mellitus (age range, 23-68 years;mean 43.1) were examined. These patients had been diabetic for 3 months to 22 years with an average duration of 5.4 years. Initially twenty-six impotent patients with diabetes mellitus were examined In the department of urology. A thorough history and levels of serum testosterone, prolactin and glucose were obtained. These patients were examined with urodynamic, neurogenic (bulbocavernous reflex, latency time detection or somatosensorial evoked potential recordings) and psychogenic tests. Each patient had a papaverine injection test in the department of urology. Finally, all patients were referred for penile color Doppler sonography and Doppler spectrum analysis of duplex scanner with color flow imaging facilities (Toshiba SSA 270-A) was used. B-Mode color, image and Doppler spectra were obtained with a 5.0 MHz linear electronically focused transducer. The wall filter was on the lowest setting so that frequency shifts of 125 Hz or less were not recorded on the velocity spectral display.

Ultrasonographic visualization of tissues of the penis and color Doppler imaging were performed with the patient supine and the penis in the anatomic position (i.e.with the dorsum against the abdomen and the ventrum exposed). The sonographic probe was placed on the ventral surface of the base of the penis in flaccid state; high resolution real time imaging was used to show anotomic details of the corpora cavernosa, cavernosal arteries and surrounding structures. Electronic cursors were used to measure the diameters of cavernosal arteries in the longitudinal projection at the proximal penile shaft and then color imaging was performed to display blood flow in the cavernous arteries. By using the color image a guide to the location and direction of flowing blood, the Doppler sample volume cursor was placed accurately, In the cavernous artery as proximal as possible in the infrapubic region, the Doppler angle correction cursor was adjusted to match the correct axis of flow. The resulting angle corrected velocity wave-form was displayed on the monitor and peak-systolic and end-diastolic velocities were measured and recorded by using the cursors.

Both cavernosal arteries were evaluated in each patient. After the initial scan, 60mg (2.0 ml) of papaverine was injected into the right corpus cavernosum by using a 25 gauge short needle. After 5 minutes to allow uniform difusion of papaverine in the corpora cavernosa and to obtain the physiologic response of penis to the papaverine, scanning was performed. All patients were observed after the examination and left the department without any complications.

Instructions were given to the patient to return to the urology deportment if the erection did not subside within 1 hr, or if excessive pain developed at any time after the injection of papaverine.

RESULTS

Of these 26 diabetic patients, 18 were insuline dependent (IDDM) and the remainder were non insuline dependent diabetics (NIDDM). Although the mean age was nearly the same in impotent and normal diabetic males, the period after the onset of DM was longer in patients with sexual dysfunction (5-8.1 years).

The corpora cavernosa and the cavernosal arteries were easily seen in both longitudinal and transverse planes. All cavernosal arteries were measured, identified and evaluated. The diameters of the cavernosal arteries were measured in the longitudinal plane. They ranged from 0.3 to 0.7mm (average 0.5) before the injection of papaverine and from 0.6 to 1.2mm (average 0.8) after the injection. The mean peak systolic velocities (the average of the peak velocity in the left and right cavernosal arteries) were examined in all patients. These ranged from 5 to 28 cm/sec (average 15.3) before the injection of papaverine and from 19 to 40 cm/sec (average 25.5) after the injection. The end-diastolic velocities ranged from -0.5 to 2 cm/sec (average 0.35) before the injection of papaverine and -10 to 14 cm/sec (average 5.8) after the injection.

The color Doppler flow ultrasonographic findings for two men with normal erections were as follows; before the injection of papaverine the diameters of the cavernosal arteries were 0.5mm. and 0.6mm, the mean peak-systolic velocities were 15 cm/sec and 25 cm/sec, the end-diastolic velocities were 0 cm/sec and

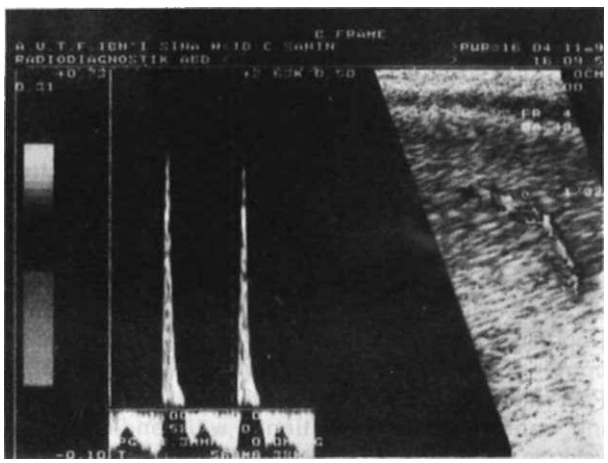

Figure 1. Color flow sonogram of a man with normal erections. Longitudinal color Doppler sonogram shows left cavernosal artery with angle-corrected cursor placement.

2 cm/sec. After the injection, they changed to Imm.and 1.2mm., 60 cm/sec and 75 cm/sec, -12 and -8cm/sec respectively. Negative values indicate reverse diastolic flow (Figure 1).

DISCUSSION

Recently,significant improvements have occurred in the evaluation, diagnosis and treatment of male impotence. These advances have been resulted by accurate understanding of the mechanism, hemodynamics and pharmacology of physiological erection as well as the pathophysiological changes in erectile dysfunction.

The combination of duplex and color Doppler sonography is a noninvasive method of examining patients with suspected vasculogenic impotence. The results obtained with color Doppler imaging parallel earlier data generated by using standart duplex sonography. In addition, assessment of penile venous competence may be helpful in identifying patients who require more invasive procedures.

Evaluation can proceed to the more invasive and more definitive digital subtraction angiography (6) or arteriography (7,8) for the assessment of penile arterial disease and dynamic cavernosometry and cavernosography (9-11) for the assessment of venous disease. Several studies have shown that penile Doppler sonography correlates well with selective arteriography in 90-95% of cases (5,12,13).

The peak-systolic velocity (Vmax) is the best indicator of arterial function. A mean Vmax value of 40 cm/sec or greater indicates good arterial response (14). If the erection angle is less than 90, in the presence of a good arterial response venous incompotence should be suspected, and cavernosometry and/or cavernosography should be performed (14). A Vmax value of less than 25cm/sec indicates severe arterial insufficiency (5,14,15,16).

Patients with Vmax values between 25 and 30 cm/sec were categorized as mild arterial insufficiency and these patients usually have enough arterial flow to respond to treatment with intracorporal self injected papaverine.

The detection of venous incompetence remains difficult with noninvasive techniques. Only significant dorsal venous leaks were detected with pulsed-wave Doppler sonography but cavernosal venous leaks could not be detected (14,16). Fitzgerald and Pouschter also reported encouraging results in predicting venous leaks in patients with end-diastolic velocities greater than or equal to 5cm/sec (17,18). In the presence of normal arterial response, persistent forward diastolic flow may be expected as the venoocclusive mechanism is not fully engaded.

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A 75% increase in cavernosal artery diameter after pharmacologic enhancement is a good indicator of adequate vessel compliance. The magnitude of change in diameter from preinjection to postinjection, however, may not correlate well with other physiologic or hemodynamic parameters.

We used color Doppler flow sonography to assess the hemodynamic function of the penis in patients with diabetes mellitus to detect the presence of arterial disease or venous incompetence. In order to assess penile venous competence, all patients were examined with dynamic cavernosography/cavernosometry.

In two patients with normal erections, the cavernous arteries dilated in early phases and the mean diameter increased from 0.55 mm to 1.1 mm (a 100% increase) after injection of papaverine. The mean peak systolic velocities increased from 20 cm/sec to 67.5 cm/sec after papaverine injection. It has been reported that in normal arterial flow, a mean peak systolic velocity of greater than 25 cm/sec is obtained injection of papaverine (5,14,15,16).

In 16 patients with diabetic impotence, we found arterial insufficiency. In these patients during the postinfection phase of the Doppler examination, peak systolic velocities were less than 25 cm/sec, and the increase in diameter of the cavernosal arteries were 60 % (Fig. 2).

In 8 patients with diabetic impotence we found normal values for peak systolic velocity and normal increases in the diameters of the cavernous arteries after papaverine injection. But end-diastolic velocities were greater than or equal to 5 cm/sec. We performed dynamic cavernosography in these patients an 9 of them were found to have venous incompotence and 17 had normal findings (Fig. 3).

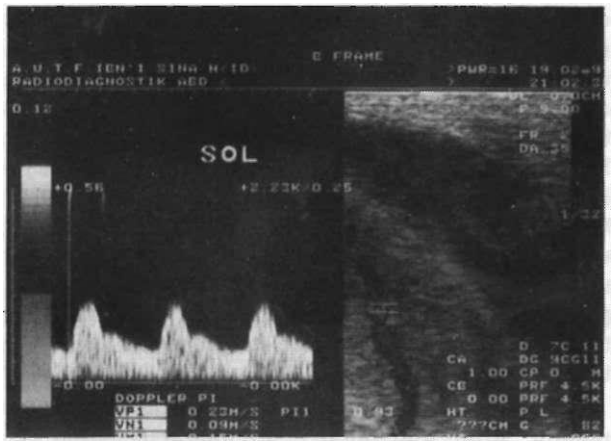

Figure 2. Doppler sonogram of a patient with penile arterial inssufficiency. Longitudinal color Doppler sonogram shows left cavernosal artery with angle-corrected cursor placement. Spectral waveform 5 min after papaverine injection shows peak-systolic velocity less than 25 cm/sec with continous diastolic flow.

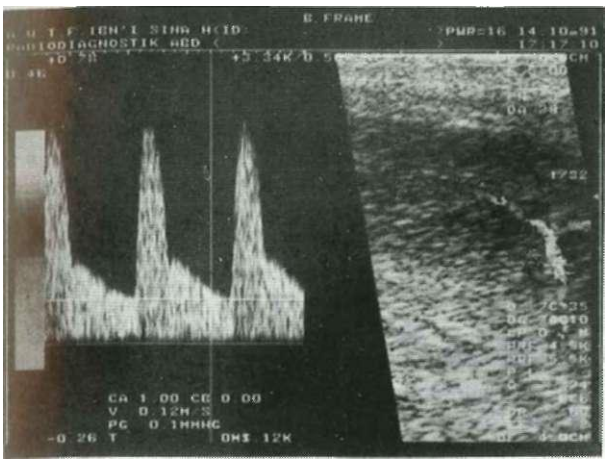

Figure 3. Doppler sonogram of a patient with penile venous leakage. Spectral wafeform in the right cavernosal artery 15 min after the injection of 60mg papaverine shows in normal peak-systolic velocity (approximately 65 cm/sec) but high end-diastolic velocity (approximately 12 cm/sec).

The color Doppler flow sonography for the evaluation of cavernosal arterial blood velocity is a promising noninvasive method in the evaluation of patients with suspected vasculogenic impotence.

Diabetlilerde vaskülojenik empotansın renkli Doppler ultrasonografi ile değerlendirilmesi

Bir yıllık süre içinde, üroloji kliniğine empotans yakınması ile başvuran, toplam 26 diabetik erkek hasta çalışma grubunu oluşturdu. Hastaların tamamı Radyodiagnostik ABD'da penil renkli Doppler görüntüleme (RDG) yöntemi ile incelenerek, diabetik impotans olgularında vaskülojenik faktörlerin rolü araştırıldı. İntrakavernözal vazoaktif ajan (papaverin) enjeksiyonu öncesinde ve sonrasında, kavernözal arterlerden pik sistolik hız (Vmax) ve diastol sonu hızlar ölçüldü. 25cm/sn ve altındaki Vmax değeri saptanan hastalara arteriyel yetmezlik; 5 cm/sn ve üzerinde diastol sonu hız değerine sahip hastalara venöz yetmezlik tanısı konuldu. Venöz yetmezliğinin kesin tanısını ortaya koymak amacı ile tüm hastalara kavernözografik ve kavernözometrik inceleme yapıldı.

26 diabetik hastanın 16'sında arteriel yetmezlik (%61.53), 8'inde venöz yetmezlik (%30.70) saptandı. 2 olgunun penil RDG bulguları tümüyle normaldi(%7.69).

RDG, Diabetes Mellitus (DM) gibi vaskülojenik faktörlerin ön plana çıktığı empotans olgularının değerlendirilmesinde tarama yöntemi olarak değer kazanmaktadır.

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