

Can bladder shear wave elastography be an alternative method for detection of neurogenic bladder instead of urodynamic study?

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ABSTRACT

Background: In the normal physiology of the bladder wall, it has sufficient elasticity so that it can maintain normal pressure during filling phase of bladder. Bladder functional pathology can cause many problems for patients. **Method:** This evaluation is a cross-sectional study conducted on patients suspected of neurogenic bladder. In this study, patient referred for urodynamic testing at first, urodynamic test performed by urologist and then Shear wave elastography was performed by radiologist. Data such as age, sex, height, and weight, and other demographic data were also evaluated. Patients were informed before and after the urodynamic and Shear wave sonography tests. Finally, the data were entered into SPSS software and were statistically analyzed. **Results:** We observed that the mean and standard deviation of the age was 15.7 ± 6.2 years. Also found that in gender 19 (63.3%) patients were males and 11 (36.7%) were female. On the other hand, in terms of BMI, most patients were normal in this regard (50%), as well as in other cases, including weight loss in 3 (10%) patients, overweight in 8 (26.6%) patients, and obese were in 4 patients (13.3%). in our assessment about the efficacy of the ultrasound elastography approach to the anterior wall, which showed that the specificity of the test in the diagnosis of neurogenic bladder was 83% and this is statistically significant in patients ($P < 0.05$). We also observed in the posterior wall posture that the specificity of this test was 85% in the diagnosis of neurogenic bladder, which indicates a high diagnostic capability of this test, and this is statistically significant in patients ($P < 0.05$). **Conclusion:** Based on the results observed in this evaluation, ultrasound elastography has a high specificity for neurogenic bladder detection in comparison with urodynamic study. Accordingly, due to the less invasive nature of this method than urodynamic study, this method can be used to identify patients with neurogenic bladder.

Keywords: Diagnosis, neurogenic bladder, ultrasound elastography

Background

In the normal physiology of the bladder wall, it has sufficient elasticity so that it can maintain normal pressure during filling phase of bladder.^[1] Bladder functional pathology, secondary to neurogenic bladder or bladder outlet obstruction, can

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disturbs this elasticity by disturbing detrusor smooth muscle.^[2,3] The prevalence of these defects is about 40% of children's urological referrals. The golden diagnostic standard of these functional pathologies is urodynamic study. Urodynamic study used diagnostic techniques that examine the function of the lower urinary system (composed of the bladder and urethra).^[4,5] This study estimates the pressure flow relationship between the bladder and urethra, and the ultimate aim of this study is to adapt the symptoms of the patient to the pathophysiology of the bladder urethra which results in a final diagnosis.^[6] These

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studies should evaluate the filling, capacity, and voiding phases of the bladder and urethra.^[7,8] The problems of performing an urodynamic test such as the need for invasive catheterization, time and cost, patient collaboration, and the obstructive effect of the catheter (especially in patients with prostate enlargement and urethral stenosis), which may make diagnostic difficult; a series of these issues led to low aggressive and simpler tests to prioritize.^[5,9]

Researches today show a proven relationship between the rate of tissue damage and the impairment of the urodynamic evaluation, in other words, factors such as capacity, compliance, and bladder pressure have a proven relationship with the structural diseases of the organ.^[10] At present, the above-mentioned urodynamic tests are considered as the gold standard for the diagnosis of bladder function.^[11,12] Research is now being made of the advancement of imaging techniques in order to eliminate and reduce as much as possible aggressive tests.^[13] One of these new findings is Shear wave elastography. Elasticity testing is one of the latest technological advances in ultrasound that measures elastic and tissue consistency especially in soft tissues.^[14,15] Accordingly, the aim of this study was to evaluate the shear wave ultrasound elastography in the diagnosis of neurogenic bladder.

Objectives

Aim of this assessment is specificity evaluation of ultrasound elastography for detection of neurogenic bladder in comparison with urodynamic study.

Patients and Methods

Study setting

It was a hospital-based study which conducted on patient with clinical manifestations of neurogenic bladder in Golestan Hospital of Ahvaz.

Study population

Study populations were all patients with clinical manifestations of neurogenic bladder. Based on this, 30 patients with these conditions, considered as study group.

Measurements

In this study, data on urodynamic study and bladder shear wave elastography results of patients who have been referred to the Center for urodynamic evaluation of Golestan Hospital in Ahvaz for various reasons during the years 1396 and 1397 have been studied over a specified period. In this study, patients who were referred for urodynamic study were first performed by a urologist on their urodynamic tests, then bladder shear wave elastography was done by radiologist. Patients were included in our study were suspected of neurogenic bladder based on history (frequency, urgency,) or ultrasound and VCUG finding (increased bladder wall thickness, bilateral hydronephrosis and bladder capacity reduction in relation to age). Data such as age, gender, height,

weight, and other demographic data of patients were also evaluated. Patients were informed about the response to side effects before the urodynamic and Shear wave sonography tests, and in case of dissatisfaction, the patients were excluded from the study.

At first, the urodynamic test was performed by the urologist and then the Shear wave ultrasonography was performed by a radiologist using a Supersonic device. Then all the information derived from the Shear wave ultrasound was compared with the results of the urodynamic study. The shear velocity of bladder tissue from the anterior and posterior wall was also measured. This velocity was measured at different scales and in different bladder conditions (based on the volume of filled bladder volume).

Ethical considerations

The study group adheres to the principles of medical ethics introduced by the Health Ministry and the Declaration of Helsinki and legislation in medical ethics committee of Ahvaz University of Medical Sciences. In addition, ethical committee of Ahvaz University of Medical Sciences approved protocol of study. In addition, this test on patients does not have an effect on the patient's treatment process and the results of the assessment are only reported to the patient, also ethical issues completely observed by authors.

Statistical analysis

The data were analyzed by SPSS program and $P < 0.05$ was considered as significant value. We consider T-test for quantitative variables and X^2 test for qualitative variables.

Results

We evaluated 30 patients with clinical manifestations of neurogenic bladder as our study group, of these, in gender 19 cases (63.3%) were male and 11 cases (36.7%) were female, also mean and standard deviation of age were 15.7 ± 6.2 years. In addition BMI of patients in 3 patients were lower than normal, in 15 patients were normal, in 8 patients were overweight and in 4 patients were obesity [Table 1].

In the evaluation of the urodynamic method, 27 of the 30 patients who had referred with clinical manifestations of neurogenic bladder, had significant diagnostic criteria for diagnosis of neurogenic bladder (compliance reduction or detrusor over activity, or both) [Table 2].

We have seen the characteristics of this test that the specificity of test for the diagnosis of neurogenic bladder was 83%(out of 24 patients in 27 cases as positive), and the positive predictive value of this test was 85 and its negative predictive value was to 87 which also indicates the diagnostic ability of this test and this is statistically significant in patients ($P < 0.05$). We also observed the posture of the posterior wall, which has been shown to be a diagnostic test of neurogenic bladder (85%) (Out of 25 patients

Table 1: Basic and Demographic Information in patients with Neurogenic Bladder

Variables	Amounts
Age (years)	
Mean	15.7
Standard Deviation	6.2
Sex	
Male	19 (63.3)
Female	11 (36.7)
BMI	
Thin	3 (10)
Normal	15 (50)
Overweight	8 (26.6)
Obesity	4 (13.3)

Table 2: Comparison results of ultrasound electrography

Variables	Shear Wave Velocity		P
	SD±Mean	n	
Anterior Wall			P<0.05
Positive	1.62±0.37	24 (80)	
Negative	1.31±0.34	6 (20)	
Posterior Wall			P<0.05
Positive	1.87±0.42	25 (83.3)	
Negative	1.13±0.34	5 (16.7)	

Table 3: Investigation of the relationship between different indices with the shear wave velocity of the bladder wall

Variables	Shear Wave Velocity		P
	SD±Mean		
Compliance			P=0.02
Normal	1.11±0.31		
Decreased	1.65±0.42		
Detrusor Over activity			P=0.008
Positive	1.69±0.26		
Negative	1.07±0.45		
Age (Years)			P=0.42
Less than 10	1.46±0.32		
15-10	1.48±0.31		
over 15	1.50±0.33		
Gender			P=0.08
Male	1.46±0.33		
female	1.50±0.31		
BMI			P=0.7
Thin	1.48±0.33		
Normal	1.47±0.30		
Overweight	1.49±0.31		
Obesity	1.45±0.34		

in 27 cases as positive), which indicates a high diagnostic capability of this test, as well as the positive predictive value of this test was 88 and its negative predictive value was 90 that was statistically significant in patients ($P < 0.05$) [Table 2].

In addition, mean and standard deviation of shear wave speed in patients with normal bladder were 1.11 ± 0.31 and in the group with abnormal bladder compliance was 1.65 ± 0.42 ,

there was a statistically significant difference between the two groups ($P = 0.02$). Detrusor over activity was also associated with shear wave speed in the bladder wall, and this was statistically significant ($P = 0.008$) [Table 3].

Discussion

We found that the ultrasound elastography has a high specificity for neurogenic bladder detection in comparison with urodynamic study; however, other studies have shown different results in this regard. In following other study that conducted for this diagnostic method has been discussed. In addition, about primary care of patients in this field we observed that, in other studies also in recent study patients can be better evaluated and primary diagnosis of patients as an alternative diagnostic method and a primary screening method. So, this method can be used for diagnosis of urodynamic condition of bladder in primary care of patients and lead to better care of patients in this level.

Sturm *et al.* reported that there was a significant difference between the shear wave speed (SWS) of the compliance and the noncompliance bladder.^[16] On the other hand, Sebag *et al.* also evaluated the value of the shear wave elastography method for differential diagnosis of benign and malignant thyroid nodules, and after statistical evaluations, they stated that ultimately 15 patients with thyroid malignancy were identified which had distinctly different findings in shear wave elastography,^[17] these results are consistent with the observations from our assessment and indicate the importance of this method. On the other hand, Naqviet *al.* in a study that evaluated the shear wave elastography technique in liver fibrosis patients, have reported that this is a relatively new method of staging and grading liver fibrosis after statistical evaluations,^[18] based on this, this method be founded as an effective method in liver evaluation. Accordingly, most studies in this field have been consistent with the results of our assessment, which indicates that this method is a less invasive and appropriate method for detection of neurogenic bladder.

Conclusion

Based on the results observed in this evaluation and, in comparison with other results in this field, bladder shear wave elastography has a high specificity for neurogenic bladder detection in comparison with urodynamic study. Accordingly, due to the less invasive nature of this method than urodynamic study, this can be used to identify patients with neurogenic bladder.

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Conflicts of interest

The authors declared no competing interests.

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