Med. J. Cairo Univ., Vol. 62, No.1, March (Suppl.): 85-93, 1994

Urodynamic Studies in Cases of Stress Incontinence

SAID AZAB, M.D.; SHAMEL HEFNY, M.D.;
SHERIF TALAAT, M.D. and MOHAMED ABD EL-AZIM, M.D.

The Departments of Gynaecology & Obsterics, Faculty of Medicine, Cairo University and El-Sahel Teaching Hospital.

Abstract

In this study we had evaluated 23 cases and 9 controls by urodynamic studies to allow careful and rational selection of patients for suitable surgical and/or medical management. According to the urodynamic tests 8 cases out of the 23 cases were excluded as having detrusor muscle instability. Fifteen cases were diagnosed as genuine stress urinary incontinence as their functional urethral lengths, their maximum urethral pressures and their maximum urethral closure pressures show significant reduction in comparison to the control group. All the cases were subjected to kelley's sutures and they are clinically cured except two cases with urethral lengths 1.3 and 1.6 who gave unsatisfactory results. We concluded that urodynamic tests are essential for the assessment of stress urinary incontinence and kelley's sutres is not the standard operation for all cases of stress urinary incontinence and Marshal-Marchetti-Krantz procedure may be the first operation of choice specially in cases associated with functional urethral length less than 1.5cm.

Introduction

INCONTINENCE or involuntary loss of urine is one of the most distressing and degrading symptom that may have a social and hygienic implication [1].

Incontinence of urine is said to happen by some degree or another in 50% of all females, even once during their life. However, 15% of them become clinically manifested to the extent of seeking medical advice.

There are many classifications to verify the dilemma of incontinence and the possible aetiology and then the possible mode of treatment. The most frequent two subtypes are; Detrusor muscle instability in which the bladder spontaneously and excessively contracts on the slightest urine collection in it. The other frequent subtype is the

Genuine stress urinary incontinence in which the bladder neck is abnormally weak or descended below the pelvic diaphragm due to congenital, traumatic or degenerative weakness of the pelvic floor muscles which could be surgically corrected.

In stress urinary incontinence there is leakage of small amounts of urine immediately upon raising the intra-abdominal pressure, when the intravesical pressure exceeds the maximum urethral pressure, but in the absence of detrusor activity.

Diagnosis and verification of urinary incontinence is reached through the classic way of methodology, i.e. histroy, clinical examination, and investigations.

Many diagnostic tests were put to help reaching the final diagnosis but still urodynamics is regarded as a main tool of evaluation. By these tests we could differentiate Genuine stress urinary incontinence from other causes of incontinence.

According to the International Continence Society, 1977, urodynamics should include: cystometry, uro-flowmetry, urethral pressure profile, and measurements of residual urine as well as electromyography.

Cystometry is a clinical test for functional assessment of the detrusor muscle. There are two basic types of cystometers based on the filling medium employed; gas cystometers (air or carbon dioxide), and water cystometers (water or normal saline) [2].

By the help of the cystometry, we can calculate the intravesical volume and pressure and first and second sensations as well as the maximum detrusor pressure.

The urinary bladder is inflated with measured volume of fluid or gas and concurrent recording of intravesical pressure proceeds. The changes of the bladder recorded on the graph.

$$\text{Volume} = \frac{\text{Chart length x puller speed}}{\text{Chart speed}}$$

Its normal range is 250 to 550 ml.

Pressure = height in cm. or Number of divisions x pressure range.

and it should not exceed 15cm H_2O during the filling phase, otherwise the patient will be diagnosed as having detrusor muscle instability.

Uroflowmetry is a test which supplies simultaneous information of detrusor function and outflow resistance. It is obtained by voiding into a receptable that converts changes in weight (gravimeter) or momentum into an electrical signal that can be graphically displayed on a strip chart recorder [3,4].

Urethral pressure profile which is a method of recording segmental urethral pressures from urethro-vesical junction to external meatus. There are three basic techniques for recording the pressure profile: perfusion, membrane catheter, or microtransducer. The perfusion method for

recording of urethral pressure profile was popularized by Brown and Wickham [5].

By means of the urethral length where the urethral pressure we can calculate:

1. Functional urethral length where the urethral pressure exceeds that of the bladder and it equals, $= \frac{\text{Chart length x puller speed}}{\text{Chart speed}}$

and its normal range is 2.4 - 2.8 cm.

2. The maximum urethral pressure which is the highest pressure attained within urethra and its normal range is 110-150 cm. H_2O.

3. The maximum urethral closure pressure which equals the maximum urethral pressure minus the intravesical pressure at rest and on sudden increase of intra-abdominal pressure and its normal range 90-130 H_2O. [6].

Residual urine is defined as the volume of urine in the bladder immediately after micturition. Measurement of residual urine is performed by catheter, cystoscope or sonographic study. It reflects the balance between retaining and expulsive forces [7].

Electromyography is valuable in patients with neurologic dysfunction. There are problems with the technique and the interpretation is difficult. The electromyogram is obtained by inserting a needle electrode into the sphincter muscles. This can be combined with gas or water cystometry [8].

Material and Methods

In our study we have evaluated 23 cases and 9 control. The 23 cases were selected from the Gynaecology Outpatient Clinic complaining of clinically diagnosed stress urinary incontinence. Their age range is from 30 to 63 years. All patients and control women enrolled in this study were subjected to detailed history with special emphasis on urinary complaint, contraception, hormonal use, parity, abnormal and excessive weight gain, mode of each delivery and its complication if present and history of previous vaginal repair operations.

General and local gynecological examination were done to all patients as well as the following investigations: Haemoglobin percent, urine analysis, urine culture and sensitivity, fasting and post prandial blood sugar testing.

All patients as well as the control group were also subjected to the following urodynamic test:

Gas cystometry and urethral pressure profile from which we calculated the urethral length, the maximum urethral pressure and the maximum urethral closure pressure.

This has been reached by using a two-channel apparatus which consists cystometry unit with CO_2 pump and a puller. The patient is instructed to empty her urinary bladder and through a Foley's Catheter No 14 CO_2 is injected in the supine position with a rate of 150mg/min.

Another, Nelaton's Catheter in the rectum is connected to the apparatus to record the intra-abdominal pressure. The changes in the pressure against the increased volume of the bladder is recorded on the graph. The patient is asked to report on the first sensation of bladder fullness (M1) and maximal urge (M2). Then she is asked to void and the pure detrusor pressure (P3) is obtained by subtracting the rectal pressure, the volume distending the bladder (V) recorded as V1 at M1 and V2 at M2.

The pressure in the bladder (P) is recorded as P1 at M1 and P2 at M2.

The chart speed was 6cm/min. Pressure range was 20Cm/H20/division.

The urethral pressure profile is obtained through a dual membrane catheter (model 56000). CO_2 is injected into the membrane chamber with a flow rate of 150 ml/min in the supine position.

The catheter is withdrawn by means of the puller at a fixed rate of 12cm/min, displaying the pressure changes throughout the whole urethra on the graph.

Table (1); Clinical Data of Cases Under Study.

No.	Name	Age	Parity	Urinary Complaint	Contra-ception	Previous rep. op.
1	Awatef M.	35y	p (4+0)	S.U.I. + Cystorectocele	----------	---------
2	Fawzya A.	37y	P (7+2)	S.U.I. + Cystorectocele	----------	---------
3	Nadia M.	40y	P(5+1)	S.U.I. + Cystorectocele	I.U.D.	---------
4	Safeya A.	36y	P(4+2)	S.U.I. + Cystorectocele	----------	---------
5	Amal F.	42y	P(6+0)	S.U.I. + Cystocele	I.U.D.	---------
6	Fatma M.	45y	P(5+0)	S.U.I. + Cystorectocele	----------	---------
7	Soad S.	39y	P(3+1)	S.U.I. + Cystocele	I.U.D.	---------
8	Wadlda A.	63y	P(5+2)	S.U.I. + Cystorectocele	----------	---------
9	Tawhida M.	40y	P(6+4)	S.U.I. + Cystorectocele	----------	---------
10	Fatheya E.	35y	P(5+2)	S.U.I. + Burning mict.	pills	---------
11	Saadeya M.	40y	P(6+1)	S.U.I. + Cystorectocele	----------	---------
12	Saneya M.	44y	P(5+5)	S.U.I. + Cystorectocele	----------	---------
13	Aziza M.	50y	P(3+0)	S.U.I. + Cystorectocele	----------	---------
14	Zenab M.	59y	P(3+7)	S.U.I. +	----------	--------
15	Nadia M.	30y	P(3+0)	S.U.I. +	----------	Cl. rep

Table (2): Clinical Data of Control Group.

No.	Name	Age	Parity	Contraception
1	Fatma F.M.	30y	P (1+0)	I.U.D.
2	Seham A.	40y	P (0+0)	--------
3	Soad A.M	45y	P (0+0)	--------
4	Eatmad S.	60y	P (5+2)	--------
5	Soad M.	52y	P (3+0)	I.U.D.
6	Nadia G.M.	65y	P (3+0)	--------
7	Elset E.	34y	P (2+0)	I.U.D.
8	Karima M.H.	32y	P (5+0)	I.U.D.
9	Loza P.	35y	P (3+1)	-------

Table (3): Results of Urodynamic Studies in Control Group:

No.	VI	P1	P2	UL	MUP	MUCP
1	115	10	15	2	105	85
2	180	10	20	28	115	85
3	140	5	8	2	160	135
4	160	20	24	2	130	100
5	130	10	12	25	135	95
6	190	20	20	2	120	63
7	130	12	17	22	120	80
8	160	12	20	25	115	90
9	140	12	15	25	115	85

V1 = Intravesical volume at lst sensation (measured in milliliters)

P1 = Intravesical pressure at lst (measured in Cm H_2O)

V2 = Intravesical volume at 2nd sensation (measured in milliliters)

P2 =Intravesical pressure at 2nd sensation (measured in Cm H_2O)

P3 = Maximum Detrusor pressure (measured in Cm H_2O)

UL = Urethral lenght (measured in Cm)

MUP = Maximum urethral pressure (measured in Cm H_2O)

MUCP = Maximum urethral closure pressure (measured In Cm H_2O)

Table (4): Results of Urodynamic Studies Patients' Group.

No.	V1	P1	V2	P2	P3	UL	MUP	MUCP
1	118	22	249	26	85	2.3	100	80
2	163	18	230	20	75	1.8	125	95
3	105	8	230	10	40	1.8	110	60
4	132	11	279	13	55	1.8	100	60
5	138	15	217	17	60	1.3	105	55
6	126	14	181	14	57	2.3	100	85
7	105	9	180	11	23	1.6	105	55
8	150	12	380	25	55	2.3	135	100
9	175	8	360	15	80	2.4		60
10	200	12	400	30	90	2.1		40
11	244	20	450	25	100	2.8		45
12	117	15	260	30	70	2.4		55
13	134	8	294	13	67	2.0		99
14	157	6	250	17	150	2.8		85
15	127	14	192	20	100	2.2		124

V1 =Intravesical volume at lst sensation (measured in milliliters)

P1 = Intravesical pressure at lst (measured in Cm H_2O)

V2 = Intravesical volume at 2nd sensation (measured in milliliters)

P2 = Intravesical pressure at 2nd sensation (measured in Cm H_2O)

P3 = Maximum Detrusor pressure (measured in Cm H_2O)

UL =Urethral lenght (measured in Cm)

MUP = Maximum urethral pressure (measured in Cm H_2O)

MUCP = Maximum urethral closure pressure (measured in Cm H_2O)

Table (5):Statistical Evaluation of Variables Under Study.

Variable	Control Group	Patients' Group	Statistical difference between mean values	
	Mean + S.D.	Mean + S.D.	"t" value	P value
Intravesical volume at lst sensation	14.4 + 23.4	146.1 + 36.5	0.2386	> 0.05
Intravesical pressure at lst sensation	12.3 + 4.6	12.8 + 4.5	0.2325	> 0.05
Intravesical volume at 2nd sensation	272.1 + 35.0	276.8 + 81.0	0.1576	> 0.05
Intravesical pressure at 2nd sensation	16.8 + 4.6	19.1 + 6.5	0.8889	> 0.05
Maximum Detrusor pressure	59.3 + 4.1	74.4 + 28.0	1.5374	> 0.05
Uaretral length	2.3 + 0.3	2.1 + 0.4	1.9743	< 0.05
Maximum urethral pressure	123.9 + 15.2	110.0 + 12.2	1.9834	< 0.05
Maximum urethral closure pressure	90.9 + 18.4	73.2 + 23.4	2.1167	< 0.05

V1 = Intravesical volume at lst sensation (measured in milliliters)
P1 = Intravesical pressure at lst (measured in Cm H_2O)
V2 = Intravesical volume at 2nd sensation (measured in milliliters)
P2 = Intravesical pressure at 2nd sensation (measured in Cm H_2O)
P3 = Maximum Detrusor pressure (measured in Cm H_2O)
UL = Urethral lenght (measured in Cm)
MUP = Maximum urethral pressure (measured in Cm H_2O)
MUCP = Maximum urethral closure pressure (measured in Cm H_2O)

Discussion

The study comprised 23 fully investigated cases of stress urinary incontinence with age range of 30-63 years. All of them were multiparas and the mean parity for them is four. All our cases were delivered vaginally and four of them had history of difficult and lengthy deliveries.

The nine control cases were selected of comparable age and parity groups as study case.

All the 23 cases were clinically free apart from the stress urinary incontinence with or without vaginal relaxation. No case had any degree of uterine descent. Urine analysis of all cases were bacteriologically free. Table (5) showed the distinction of all urodynamic variables mean among patients and control. As we can see, the intravesical volume and pressure at first and second sensations, as well as the maximum detrusor pressure of both patients and control groups did not show any significant difference ($p > 0.05$).

These results agree with that of Coolsact [9]. This finding is quite explicable by the underlying pathophysiology of stress urinary incontinence in which the main and perhaps the only effect is at bladder neck rather than elsewhere.

Using the above diagnostic criteria and urodynamic findings, eight cases out of the 23 cases under study were excluded of being detrusor muscle instability rather than genuine stress urinary incontinence. This has been done by the finding that their cytometric variables (V1 and V2) are much reduced and (P1 and P2) are much elevated as well as the maximum detrusor pressure. These eight cases received anticholinergic drugs (Probanthene) and showed a good response but we didn't give antibiolotic to them because all of them have sterile urine. The 15 cases proved to have genuine stress urinary incontinence showed significant reduction in the urethral length, the maximum urethral pressure and the maximum urethral closure pressure ($p < 0.05$) as shown in Table (5).

They were all subjected to Kelley's sutures with or without vaginal repair operation. Of them 13 cases were clinically cured. But patient No. 5 and 7 (Table 4) with urethral length (1.3 and 1.6 cm respectively) didn's give satisfactory results.

We concluded that urodynamic assessment is an essential tool in the management of stress urinary incontinence. Cystometric studies are essential in exclusion of detrusor muscle instability rather than proof of genuine stress urinary incontinence which can be diagnosed more precisely by the urethral pressure profile and more so by applying the stress pattern on the unrodynamic in which there is simultaneous measurement of both intravesical and intraurethral pressure after sudden increase of intra-abdominal pressure.

We could conclude also that kelley's sutures is not the standard operation for all cases of stress urinary incontinence and

Marshall-Marchetti-Krantz procedure may be the first choice especially so if the urethral length is less than 1.5 cm.

References

1. INTERNATIONAL CONTINENCE SOCIETY. STANDARDIZATION COMMITTEE: The standardization of terminology related to lower urinary tract function: First Report. Scand J. Urol. Nephrol., 1: 193-196, 1977.

2. THOMAS D.G.: Clinical urodynamics in neurogenic bladder dysfunction. Urol. Clin. North Am., 6: P237, 1979.

3. CARDUS D.; QUESADA E.M. and SCOTT, F. B.: Use of an electromagnetic flowmeter for urine flow measurements. J. Appl. Physiol., 18: 845-847, 1963.

4. SIROKY M.B.; OLSSON C.A. and KRANE R.J.: The flow rate normogram: I. Development. J. Urol., 122: 665-668, 1979.

5. BROWN M. and WICKHAM J.E.: The urethral pressure profile. Br. J. Urol., 41: 211, 1969.

6. ASMUSSEN M. and ULMSTEN, U.: Simultaneous urethrocytometry and urethral pressure profile measurement with a new technique. Act. Obstet Gynecol. Scand., 54: 385, 1975.

7. GRIFFITHS D.J.: Urodynamics. Bristol, Hilger. Quoted by Bannett and Urodynamics. Bristol, Hilger. Quoted by Bannett and Wein, Controversies in Neurourology, 33, 1980.

8. OSTERGARD D.R. and McCARTH T.A.: Diagnostic procedures in female urology. Am. J. Obstet. Cynecol., 137: 401, 1980.

9. COOLSAET BLRA: Cystometry. In: Clinical Gynaecologic Urology. Stranton SL (eds). CV Mosby, p 59, 1984.