Urological Research 6, 141-146 (1978)

Urological Research

Evaluation of Urodynamic Studies by Computer

Udo Jonas, Eckhard Petri, and Peter Banse

Department of Urology, University of Mainz Medical School, Mainz, F.R.G.

Accepted: April 4, 1978

Summary. In an attempt to simplify urodynamic evaluation, the data obtained from cystometry, urethral profile and flowmetry were analysed using the ICS recommendations for standardization and terminology. All studies were compiled from check lists feasible for computation. The aim was to establish standards and "typical" changes for the normal bladder and pathological states to enable automatic readout of computed data. The results did, in fact, show "typical" changes but failed to establish standard measurements suitable for completely computed diagnoses.

Key words: Urodynamic evaluation - Computed cystometry - Computed urodynamics - Standard urodynamic values.

Growing interest in urodynamic studies of the lower urinary tract has led to the increasing need to establish standards in terminology, equipment and normal values, in order to compare data obtained by different examiners (1, 2). Since urodynamic data have not yet been standardized, an attempt was made to determine typical values for normal patients and specific pathological changes. In addition, the feasibility of computing the evaluation of cystometric, flowmetric and urethral pressure profile parameters was tested.

MATERIAL AND METHODS

Data obtained from 300 urodynamic studies were computed according to the International Continence Society suggestions on standardisation and terminology (1, 2) (Table 1).

The technique used for the studies, reported previously (3), is as follows: the patient is studied in a sitting position on a specially designed toilet chair in front of the x-ray-television unit (Fig. 1). Pressure recordings from the bladder, urethra and rectum are obtained, as well as electromyogram (EMG) registration of the pelvic floor musculature and flow- and voided volume recordings. All data is stored on analogue magnetic tape with read-out either on a memory oscilloscope or a multi-channel high frequency recorder. X-ray and chart are documented via a video mixer on a video tape, allowing correlation of morphology (cystofluoroscopy) and data (chart).

A membrane catheter (4) is used for simultaneous bladder and urethral pressure recordings.

Table 1

300 Consecutive Urodynamic Studies		
Male:	83	
Female:	217	
Age Groups		
1 - 7	7	children : 32
8 - 15	25	
16 - 31	35	
32 - 51	136	
52 - 71	90	
> 72	7	

0300-5623/78/0006/0141/$01.20

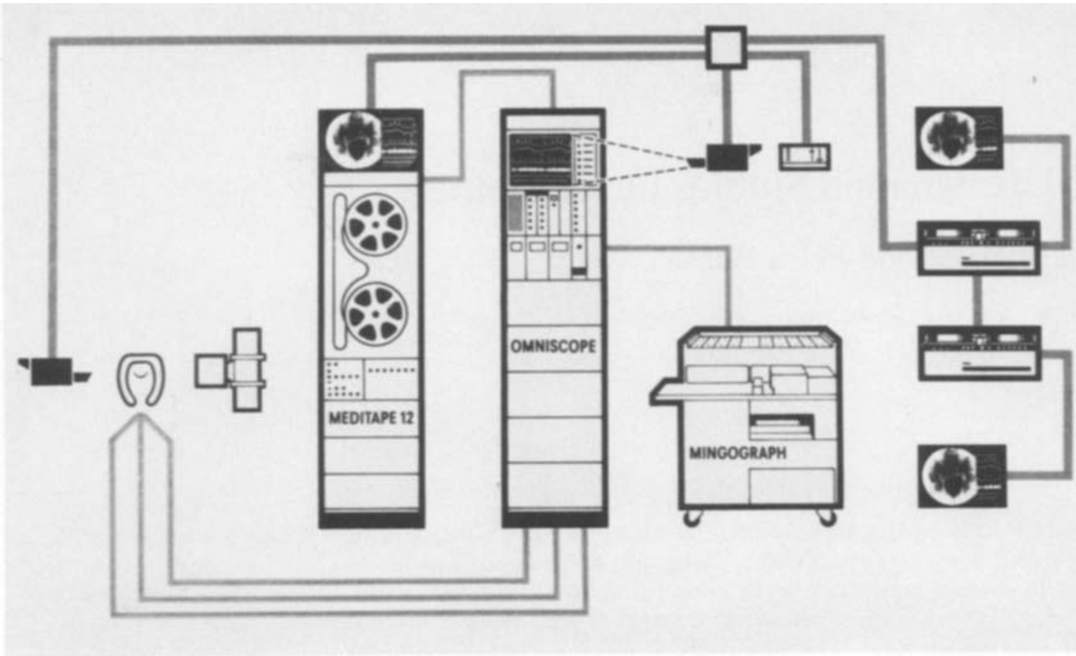

Fig. 1. Urodynamic unit with data storage and combined video and data documentation. For details, see tex

Table 2. The indications for urodynamic studies in 300 patients

Indication	n =		%	
Incontinence	171		57	
stress		137		45.7
urge		19		6.3
total		15		5.0
Neurogenic bladder	55		18.4	
Iatrogenic		30		10.0
Trauma		10		3.4
Meningomyelocele		7		2.3
Multiple sclerosis		5		1.7
M. Parkinson		3		1.0
Obstructive disorders	34		11.3	
Dysuria	27		9.0	
Pollakisuria		15		5.0
Nocturia		6		2.0
Alguria		6		2.0
Enuresis	13		4.3	

Table 3. Diagnosis based an urodynamic studies in 300 patients

Diagnosis	n		%	
Normal	84		28	
Incontinence	140		46.7	
Stress		61		20.3
Urge - motor		35		11.7
Urge - sensory		5		1.7
Total		26		8.7
Overflow		13		4.3
Neurogenic bladder	60		20	
Complete UMNL above T6		1		0.3
Incomplete UMNL above T6		1		0.3
Complete UMNL below T6		2		0.7
Incomplete UMNL below T6		12		4.0
Complete LMNL central		2		0.7
Incomplete LMNL central		8		2.6
Incomplete LMNL peripheral		12		4.0
Upper somato, lower viscero-motor neurone lesion		3		1.0
Upper viscero, lower somato-motor neurone lesion		11		3.7
Incomplete mixed lesion		6		2.0
Sensory neurone lesion		2		0.7
Obstructive bladder disorders	16		5.3	

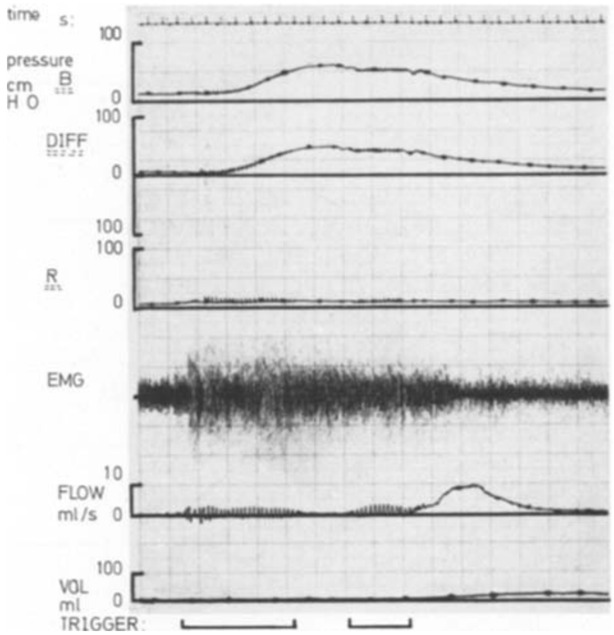

Fig. 2. Combined pressure, flow and EMG study in a patient with a supranuclear lesion. For details, see text

EMG-recordings are obtained with a coaxial needle positioned in the pelvic floor. Figure 2 shows a typical chart of a patient with supranuclear lesion: by triggering (suprapubic tapping), a detrusor contraction is evoked, but a high spastic external sphincter pressure (detrusor-sphincter dyssynergia) impedes voiding until relaxation, after which voiding occurs. The differential pressure (bladder pressure minus rectal pressure) indicates detrusor contraction.

The indications for performing the urodynamic studies were primarily incontinence (57 %) and neurogenic disorders (17.6 %) (Table 2).

RESULTS

Table 3 shows that almost 30 % of the patients showed normal urodynamic findings. It was of interest that a neurogenic bladder was diagnosed urodynamically in 12.8 % of patients who had not shown any clinical signs of a neurological disease.

Based on approximately 200 parameters for each of 300 patients studied urodynamically, mean values for cystometry, urethral profile and flow measurements were determined. It must be mentioned that the flow studies were performed in combination with cystometry, therefore the flow data were not free of interference from rectal and bladder catheters, EMG needles and lack of privacy.

Table 4. Mean values in normal patients

Cystometry	
Maximum cystometric capacity	413 ml
Residual urine	<15 % capacity
Compliance	19.9 ml/cm H_2O
First desire to void	60 % capacity
Involuntary detrusor contraction	none
Voluntary detrusor contraction	42.0 cm H_2O
Intravesical pressure on straining	59.2 cm H_2O
Urethral profile	
Maximum urethral closure pressure	45.6 cm H_2O
Functional profile length	2.4 cm ♀ 3.2 cm ♂
Flowmetry[a]	
Flow time	58.8 s
Maximum flow rate	20.9 ml/s
Average flow rate	7.1 ml/s
Maximum flow time	19.7 s

[a] Combined study of flowmetry and cystometry

Normal values (Table 4) were based on the mean values in normal patients. The mean values of the following 5 pathological situations were then plotted against those values considered "normal" (Tables 5-7):

Incontinence:	stress urge overflow
Neurogenic bladder:	upper motor neuron lesion (UMNL) lower motor neuron lesion (LMNL)

Table 5. Mean cystometric values in 5 pathological states compared with findings in normal bladders (■ = equal; ↑ = increased; ↓ = decreased)

	Incontinence			Neurogenic bladder	
	Stress	Urge	Overflow	UMNL	LMNL
Maximum cystometric capacity	■	↓	■	↓	↑
Residual	■	↑	↑	↑	↑
Compliance	■	■	↑	↓	↓
First desire to void	■	■	↑	■	■ → ∅
Involuntary detrusor contraction	■	↑	↑	↑	■
Voluntary detrusor contraction	↓	↓	↓	↓	↓
Intravesical pressure at bear down	■	■	■	■	↑

Table 6. Mean urethral profile values in 5 pathological states compared with normal profile (■ = equal; ↑ = increased; ↓ = decreased)

	Incontinence			Neurogenic bladder	
	Stress	Urge	Overflow	UMNL	LMNL
Maximum urethral closure pressure	↓	■	■	■	■
Functional profile length	↓	■	■	↓	■

Table 7. Mean flowmetry values in 5 pathological states compared with normal flows (■ = equal; ↑ = increased; ↓ = decreased)

	Incontinence			Neurogenic bladder	
	Stress	Urge	Overflow	UMNL	LMNL
Flow time	■	↓	■	■	↑
Maximum flow rate	↑	■	↓	↓	↓
Average flow rate	■	↓	■	↓	↓
Maximum flow time	■	↓	↓	↓	↑

25 patients (8.4%) showed various combinations of the conditions listed in Table 3. Since this small number impeded statistical evaluation, however, the cardinal symptom attributed to these patients was used to establish an "isolated" diagnosis suitable for computation. As seen in Table 5, the parameter of "voluntary detrusor contraction" was of no help in differentiating the 5 diseases.
In essence, the characteristic features were:

Stress Incontinence. No residual urine, decreased maximum urethral closure pressure, increased maximum flow rate and normal maximum flow time.

Urge Incontinence. Decreased maximum cystometric capacity and flow time, but normal maximum flow rate.

Overflow Incontinence. Increased compliance and delayed desire to void.

Upper Motor Neurone Lesion (UMNL). Decreased maximum cystometric capacity and decreased functional profile length.

Lower Motor Neurone Lesion (LMNL). Increased maximum cystometric capacity, increased intravesical pressure with straining, increased flow time and maximum flow time.

DISCUSSION

With the help of the computer, it was possible to determine some typical changes for the main diseases leading to lower tract disturbances based on mean values. However, overlapping of minimum and maximum values in most studies invalidated the evidence.

Comparing Table 2 and 3, it becomes evident that almost 30 % of patients with clinical problems were considered "normal" in the urodynamic study. These were mostly patients in the incontinence group and the clinical symptoms could not be confirmed objectively. These urodynamically "normal" patients in general showed only mild symptoms. Comparison of the normal values with these from patients with different pathological conditions showed that, apart from some clinically evident features, such as increased maximum cystometric capacity (infranuclear lesion group) or decreased maximum urethral closure pressure (stress incontinence), only a few specific parameters were of use.

For an accurate urodynamic diagnosis, it is necessary to analyse curves of as many simultaneously recorded parameters as possible. Therefore, despite sophisticated electronic equipment, the examiner is still the key figure in diagnosing urodynamic disturbances.

Urol. Res., Vol. 6, No. 3 (1978)

The analysis of purely numerical information obtained from completely mechanised evaluation of urodynamic studies provides insufficient data for an accurate urodynamic diagnosis.

REFERENCES

1. Bates, C. P., Bradley, W. E., Glen, E., Melchior, H., Rowan, D., Sterling, A., Hald, T.: Die Funktion der unteren Harnwege. Urologe A 15, 93 (1976)
2. Bates, C. P., Bradley, W. E., Glen, E., Melchior, H., Rowan, D., Sterling, A., Hald, T.: First report on the standardisation of terminology of lower urinary tract function. British Journal of Urology 48, 39 (1976)
3. Jonas, U., Hohenfellner, R.: A new concept of urodynamic evaluation of the lower urinary tract. Urologia Internationalis 33, 27 (1978)
4. Tanagho, E. A., Jonas, U.: Membrane catheter. Urology 10, 173 (1977)

Prof. Dr. U. Jonas
Department of Urology
University of Mainz Medical School
Langenbeckstraße 1
D-6500 Mainz
Federal Republic of Germany