URODYNAMIC EVALUATION OF LOWER URINARY TRACT FUNCTION IN THE NEUROGENIC BLADDER

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SUMMARY

Analysis of the investigations of 14 cases of spinal injury are presented. The significance of the level of injury and the pattern of bladder function is alluded too. Some aspects of the management of neurogenic bladder are discussed.

INTRODUCTION

Bladder outlet obstruction developing in patients with complete or incomplete injury to the spinal cord would in the usual course of events determine the prognosis of patients with such injury. As much as 40–43% of all patients with spinal cord injury will eventually die of renal disease.[1] In the attempt to prevent these lethal complications, it is imperative that the physician tending to such patients divert his attention in trying to identify which of his patients will eventually have vesical outlet obstruction and manage them adequately.

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MATERIALS AND METHODS

14 patients with varying degrees of paraplegia admitted to the Universiti Kebangsaan Malaysia Orthopaedic Unit were included in this study. All patients had excretory urograms and micturating cystograms before being investigated urodynamically. DISA 21 F 16 was used in all the investigations. Investigations performed were water and CO_2 cystometry and urethral pressure profiles (in supine and sitting positions).

RESULTS

All the 14 patients studied were male. Seven of the patients were between three to five years from the onset of paralysis, five of them between one to two years and one was less than six months from the onset of paraplegia. One of the patients was paralysed for a period of about 10 years. The age distribution showed a peak incidence between the second and third decades of age. Paralysis was due to trauma in 13 patients and transverse myelitis in one.

Patients were classified according to level of the lesions:

Group I: Cervical cord lesions entirely above the sympathetic outflow. **Group II:** Lesions between the thoracic segments T_1 & T_{10}. **Group III:** Lesions with the sensory level between T_{11} & L_2; **IIIa:** bulbocavernosus reflex positive indicating viability of sacral segments; **IIIb:** bulbocarvernosus reflex negative. **Group IV:** Conus or cauda equina lesions involving the somatic and parasympathetic outflow of the bladder and urethra but below the sympathetic outflow.

Cystometry

Cystometry was performed with CO_2. Under sterile conditions a Foley catheter was introduced into the bladder and the residual urine was noted. The cystometry hose is connected to CO_2 outlet of the cystometer. Studies of the maximum detrusor pressures in relation to the spinal cord level are shown in Table I. Higher detrusor pressures were obtained with the more cranial lesions.

TABLE I
MAXIMUM DETRUSOR PRESSURES WITH CYSTOMETRY

Patient	Neurological level	Destrusor pressure in cms of water		Average in groups (cm)
L	C_5	75	GpI	107
A	C_6	140		
H	T_7	84		
E	T_8	101		
D	T_{10}	17		
G	T_{10}	39	Gp II	57.8
J	T_{10}	39		
B	L_1	35		
K	L_1	18		
M	L_1	35		
I	L_2	73	Gp III	32
C	L_3	25		
N	L_4	25		
F	L_5	10		

The average of patients with cervical lesions (Group I) was 107 cms of water, while those with thoracic lesions (Group II) was 57.8 cms of water.

In Group III the average maximum detrusor pressure of 32 cms of water was noted.

Urethral Pressure Profilometry

The urethral pressures were measured using a single lumen catheter withdrawn mechanically thereby recording to pressures along the whole length of the urethra (Fig. I). Maximum pressures are obtained at the bladder neck sphincter complex region.

Studies of the various detrusor pressures on cystometry in relation to urethral pressure profiles are shown in Table II. Straining considerably increases recorded detrusor pressure in patients who having sparing of their intra-abdominal muscles.

Patients with lesions above T_{10} tend to have greater sphincter pressures and those with lesions below T_{10} have lower values except in three patients (IN & C). Urethral pressures were consistently higher in the supine position.

DISCUSSION

Urodynamic procedures are performed in an unfamiliar setting and thus psychic inhibitions

Fig. 1 Urethral pressure profile measurement.

TABLE II
DETRUSOR PRESSURE RECORDINGS WITH URETHRAL PRESSURE PROFILE OF PATIENTS

Patient	Neurological level	Detrusor pressure cms H_2O		Sphincter Pressure cms H_2O	
		Maximum	Subsidiary	Sitting	Supine
D	T_{10}	17	23	13	12
B	L_1	23	25	21	11
K	L_1	18	45	42	32
M	L_1	35	66	22	12
F	L_5	10	80	24	18
L	C_5	75	110	32	19
A	C_6	77	105	37	22
H	T_7	84	74	28	24
E	T_8	101	100	24	18
G	T_{10}	31	39	34	26
F	T_{10}	39	46	36	26
I	L_2	72	105	40	43
N	L_4	28	38	73	64
C	L_4	59	150	33	15

may significantly alter voiding process (Fig. 2). However in spinal trauma bladder function tends to revert back phylogenetically to a spinal level when the total coordination is taken over by the spinal bladder centre. Hence in this situation the urodynamic data can be critically evaluated best and meaningful diagnostic information be obtained. Cystometry is a graphic representation of the changes in vesical pressure as a function of the volume (Fig. 3). In patients with complete or incomplete neurological lesions above the sacral micturition centre there is a lowered threshold for bladder contractions which is due to the net facilitatory effect at segmental levels. This is clearly seen in patients with cervical and thoracic lesions (average maximum detrusor pressure in Groups I and II being 107 and 37.8). Valsalva manoeuvre does tend to respectively raise the intrinsic detrusor pressure by an added intra-abdominal component in most patients due to some straining of diaphragm and abdominal muscles.

In patients with lesions below T_{10} the bladder is generally hypotonic, low pressures are consequently recorded (patients D, B, K, M and F). Three patients (I, N and C) had conflicting results and in spite of being below L_2 exhibited hypertonicity of detrusor function. Patients with spinal cord lesions are often unable to void because of the failure of the external sphincter complex to relax (detrusor sphincter dys-synergia). Hence in patients with neuropathic bladder disorders it is very relevant to consider this 'static' pressure in the region of the bladder neck and external sphincter, or maximal urethral pressures critically in that this pressure needs to be overcome with a strong sustained detrusor contraction for urine to flow. Table II shows that most of the sphincter pressure recorded in the patients are lower than the maximum detrusor pressure recorded on cystometry and certainly less than values of detrusor muscle pressures on straining as well. Hence it would be correct to assume that evacuation would be

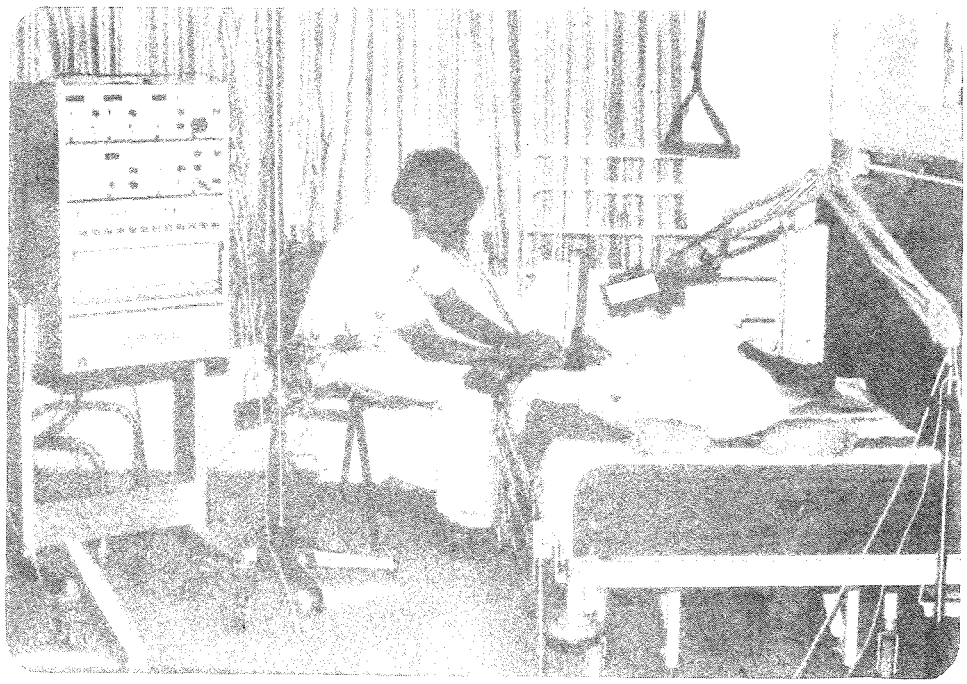

Fig. 2 Urodynamic Armamentarium

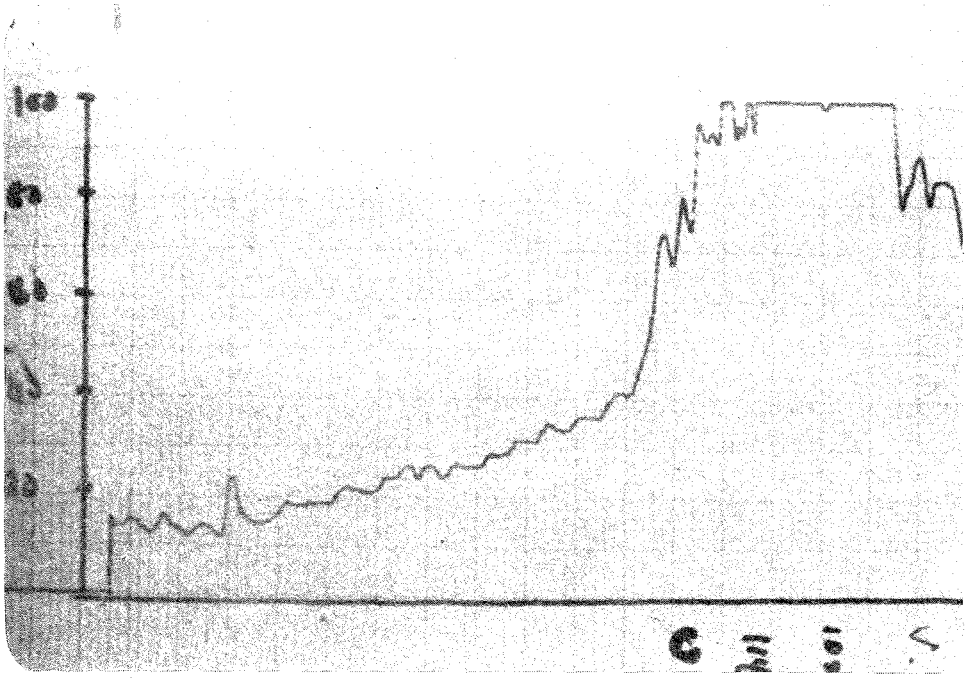

Fig. 3 Cystometrogram of a hypertonic detrusor

satisfactory if the pressures generated in the detrusor are sustained during evacuation.

It is evident that the maximum sphincter pressures increase in the sitting position i.e. all patients. Several explanations have been tendered to explain this phenomena and it is now considered to be due to a increase in contraction of the smooth muscle. This postural response elicited is observed in patients with all levels is perhaps brought about by either a 'reflex' or humoral. Catecholamines have been shown to be increased in assuming the upright position and it has been suggested that this increase combined with an increase in sensitivity of the adrenergic receptors could result in increase in the urethral pressure 3.

Three patients with Group III lesions (I, N and C) however had hypertonic bladders and this would mean that it is not possible to predict in all cases whether a hypertonic or hypotonic bladder would develop according to level of the lesion.

The programme of bladder rehabilitation i.e., patients with acute spinal trauma is initiated after the stage of spinal shock has abated. By then most of the priorities of acute trauma would have been settled. The management has been elaborated elsewhere[4] but it would suffice to mention that a balanced bladder with little residual volume is aimed for. Urodynamic study would best be reserved for patients with problems and for patients with high residual urine volumes. They are helpful in the diagnosis of atonicity and in localization of sites of dynamic obstruction. Such obstruction could then be dealt with endoscopically.

CONCLUSION

It is evident from this preliminary urodynamic study that in at least some patients it is difficult to predict the type of neurogenic bladder according to specific spinal level. Furthermore urodynamic evaluation of lower urinary tract function in paraplegic patients gives an insight to the complex problems that could arise in paraplegics whose evacuation of urine is unsatisfactory.

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