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Evaluation of Patients with Neurogenic Bladder Following Lumbar and Lumbosacral Disc Herniation Surgery: A Retrospective Cross-Sectional Study

Lomber ve Lumbosakral Disk Herniasyon Cerrahisi Sonrası Nörojenik Mesaneli Hastaların Değerlendirilmesi: Retrospektif Kesitsel Bir Çalışma

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ABSTRACT Objective: The aim of this study was to explore the urodynamic features and renal/bladder functions in patients following lumbar or lumbosacral disc herniation surgery. **Material and Methods:** This retrospective study included 28 patients with a history of lumbar disc herniation surgery. Demographic and clinical data were collected. Data comparisons were performed in the subgroups according to gender, bladder filling sensation, and postoperative duration. **Results:** A total of 28 patients (16 males, 12 females) with a mean age of 52.9±12.7 years were enrolled. The mean duration since the lumbar disc operation was 26.1±27.1 months. When the patients were allocated two groups with respect to postoperative duration (<6 months, ≥6 months), statistically significant difference was observed in emptying method at admission (p=0.024). Similarly, when the patients were allocated two groups with respect to gender (male-female) statistically significant difference was observed in emptying method at admission (p=0.049). Frequency of indwelling urethral catheter use was higher in male patients and in patients with postoperative duration <6 months while spontaneous voiding/emptying without catheter frequencies were higher in female patients and in patients with a postoperative duration of ≥6 months. **Conclusion:** Higher indwelling urethral catheter frequencies were observed in patients with short postoperative duration and in male patients. Evaluation of the patients with indwelling urethral catheters as soon as possible and shifting to spontaneous voiding or intermittent catheterisation will diminish the side effects of indwelling urethral catheters in these patients.

Keywords: Neurogenic bladder; lumbar disc herniation; urodynamic evaluation

ÖZET Amaç: Bu çalışmanın amacı, lomber ve lumbosakral disk hernisi cerrahisi sonrası hastaların böbrek, mesane fonksiyonları ve ürodinamik özelliklerini araştırmaktır. **Gereç ve Yöntemler:** Bu retrospektif çalışmaya lomber disk hernisi cerrahisi geçirmiş 28 hasta dâhil edildi. Demografik ve klinik veriler toplandı. Alt gruplarda cinsiyet, mesane dolum hissi ve postoperatif süreye göre veri karşılaştırmaları yapıldı. **Bulgular:** Yaş ortalaması 52,9±12,7 yıl olan toplam 28 (16 erkek, 12 kadın) hasta çalışmaya alındı. Lomber disk operasyonundan bu yana geçen ortalama süre 26,1±27,1 ay idi. Hastalar hastalık süresine göre (<6 ay, ≥6 ay) iki gruba ayrıldığında, başvuru sırasındaki boşaltma yönteminde istatistiksel olarak anlamlı farklılık gözlendi (p=0,024). Benzer şekilde, hastalar cinsiyete göre (erkek-kadın) iki gruba ayrıldığında başvuru sırasındaki boşaltma yönteminde istatistiksel olarak anlamlı farklılık gözlendi (p=0,049). Kalıcı üretral kateter kullanım sıklığı erkek hastalarda ve hastalık süresi <6 ay olan hastalarda daha yüksek iken, katetersiz spontan işeme/boşaltma sıklığı kadın hastalarda ve hastalık süresi ≥6 ay olan hastalarda daha yüksekti. **Sonuç:** Postoperatif süresi kısa olan hastalarda ve erkek hastalarda daha yüksek kalıcı üretral kateter kullanım sıklığı gözlendi. Kalıcı üretral kateter kullanan hastaların en kısa sürede değerlendirilmesi ve spontan işeme veya aralıklı kateterizasyona geçilmesi, bu hastalarda kalıcı üretral kateterin yan etkilerini azaltacaktır.

Anahtar Kelimeler: Nörojenik mesane; lomber disk herniasyon; ürodinamik değerlendirme

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Parasympathetic and somatic system innervation of the lower urinary tract, pelvic floor muscles, and the bladder sphincter can be affected by disc problems at any level of the lumbar region of the spine. Neurological changes include autonomic and somatic fiber damage.[1,2] In addition, intervertebral disc hernia is a frequent disc disease, which is an important cause of neurogenic dysfunction of the bladder.[3,4]

Clinical assessment of neurogenic bladder is necessary for optimal and successful management. Clinicians should evaluate all the history of changes and features of urinary system functions, including the presence of bladder filling sensation (BFS), urological problems and signs, leakage, emptying/storage symptoms, emptying method (indwelling catheter, intermittent catheterization, emptying without catheter and spontaneous voiding) and prescribed medical drugs.[5] In addition, the importance of objective laboratory analysis in renal function monitoring for neurogenic bladder is clear. Serum creatinine level and creatinine clearance are the most recommended analyses for the follow-up of renal functions in these patients.[6,7]

Lower urinary tract dysfunction with matching urodynamic findings have been reported in a large percentage of patients with disc disease.[8-10] There are variable surgical options for herniated disc management, including micro discectomy, percutaneous discectomy, and open discectomy with or without foraminotomy. However, there is limited knowledge about the effects on bladder function of these surgical management methods.[2]

Patients with neurogenic bladder must be protected from devastating renal problems such as hydronephrosis, renal stones, and chronic pyelonephritis, as these problems can lead to renal atrophy and functional failure if not treated properly. Hydronephrosis is an anatomical sign of dilation of the renal collecting system which can be detected with imaging techniques of the upper urinary tract.[11] However, hydronephrosis may remain asymptomatic for a long time, so follow-up imaging of the urinary system is very important for proper and protective management.[12] Non-invasive ultrasonographic examination is a cost-effective and useful method for long-term follow-up.[13] Although the optimal frequency is not clear, urodynamic studies have been confirmed in the literature as one of the cornerstones of follow-up monitoring in patients with neurogenic bladder.[14] However, the investigation of urodynamic studies together with above issues in patients who have undergone lumbar discopathy herniation surgery is limited.[2] Therefore, the aim of this study was to investigate renal and bladder functions, using urodynamic studies, clinical features, laboratory tests, and renal system imaging in patients who had undergone lumbar disc herniation surgery.

MATERIAL AND METHODS

This retrospective study included 28 patients who had undergone a lumbar or lumbosacral disc herniation operation and had been referred to the urodynamics unit due to lower urinary tract dysfunction between 2010 and 2018 in a tertiary hospital. All procedures in this study were approved by the Ankara Numune Training and Research Hospital Ethics Committee (date: April 26, 2017, no: 1373/2017). The patients gave consent for the publication of the clinical details and all clinical investigation was conducted according to the principles expressed in the Declaration of Helsinki. The age, gender, interval between the lumbar disc operation and the urodynamic study (postoperative duration) features of the patients were recorded. A retrospective analysis was made of the urodynamic unit records of the patients.

The same clinician performed all the urodynamic examinations with the same urodynamic measurement system MMS Solar (MMS, Enschede, The Netherlands). Patients were positioned supine on a urology table and a 7-Fr 2-lumen urological catheter was introduced transurethrally for the filling phase of the examination. The bladder was emptied before the start of the urodynamic study. Sterile saline at room temperature was used for continuous medium fill cystometry at a rate of 50 mL/min. Before the study, 3 conditions were defined to explain BFS C. Patients were told to report the first sensation of bladder filling, the first desire to void and a strong desire to void, but not to report if they do not feel anything.[15-17] Unavoidable leakage, a strong desire to void and, 40 cm/H_2O or higher intravesical pressure were the cri-

teria for terminating the filling phase. Analysis was made of overactivity and compliance, BFS, maximum cystometric capacity (mL), pressure at maximum flow (cm/H_2O), voided volume (mL), and post-voiding residual urine (mL).

The urodynamic parameters of the filling and voiding phases were used to evaluate storage and emptying disorder. Bladder capacity was accepted as normal if the lower limit of the bladder was 300 mL.[18,19] If the measured maximum cystometric capacity during the filling phase was >300 mL, it was accepted as a storage disorder. Emptying disorder was accepted when the post-voiding residual volume was ≥50 mL at the end of the voiding phase. The data were collected for prescribed emptying methods (indwelling catheter, intermittent catheterization, emptying without catheter and spontaneous voiding) and medical drugs (anticholinergic, alpha-blocker). The BFS was classified as preserved (the same as it was before the disc disease), partially preserved (different in quality or magnitude), or absent.[20]

Detrusor type was classified as normoactive, overactive, or underactive and the detrusor hypocompliance was identified as absent or present.[21] Detrusor compliance was accepted as normal when the pressure of the detrusor was ≥20 mL/cmH_2O and as hypocompliance when the pressure of the detrusor was <20 mL/cmH_2O.[18]

Signs of renal stones, hydronephrosis and chronic pyelonephritis on any renal ultrasonography (USG) or intravenous pyelography (IVP) performed during the follow-up period were accepted as upper urinary tract deterioration.[22] Trabeculation or increased wall thickness of the bladder was accepted as abnormal findings of bladder USG.

STATISTICAL ANALYSIS

Data obtained in the study were analysed statistically using SPSS vn 15.0 software (SPSS Inc., Chicago, IL, USA). The independent samples t-test was used for the comparison of descriptive statistics and measured parameters. The Pearson chi-square test was used for comparison of categorical parameters. A value of $p<0.05$ was accepted as statistically significant.

RESULTS

Among 47 patients who were assessed for eligibility, 28 of them were included and assessed. The flow diagram of subject inclusion is depicted in Figure 1. Mean age of the patients was 52.9±12.7 years. The demographic, clinical, laboratory, urodynamic, microbiological, and renal/bladder USG imaging features of the patients are shown in Table 1. The mean duration since the lumbar disc surgery was 26.1±27.1 months. The comparison of demographic, clinical, urodynamic, laboratory, and imaging features of the patients according to gender, BFS, and postoperative duration are presented in Table 2. No statistically significant difference was determined between the male and the female patients according to demographic, clinical, laboratory, microbiological, and renal/bladder USG imaging features ($p>0.05$) except emptying method at admission ($p=0.049$). In the comparisons of patients with normal BFS and abnormal BFS, significant differences were determined in presence of bacteriuria ($p=0.028$) and colonised urine culture frequency ($p=0.028$), and no statistically significant difference in demographic, clinical, laboratory, and renal/bladder USG imaging features. When patients were grouped according to postoperative duration, there were no statistically significant differences between the groups with respect to demographic, clinical, laboratory, microbiological, and renal/bladder

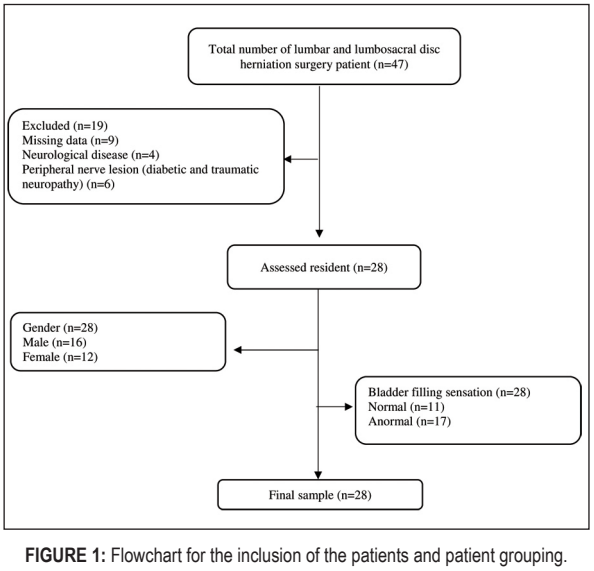

FIGURE 1: Flowchart for the inclusion of the patients and patient grouping.

TABLE 1: Demographic and clinical data, laboratory findings, and imaging features of patients.

Variables	Result
Age (years)	52.9±12.7
Gender M/F	16/12 (57.1%/42.9%)
Postoperative duration (months)	26.1±27.1
Maximum cystometric capacity (mL)	458.2±169.2
Maximum flow rate (mL/s)	6.8±8
Pressure at maximum flow (cm/H_2O)	37.7±14.8
Voided volume (mL)	162.1±194.1
Post-voiding residual urine (mL)	297.7±297.7
Detrusor overactivity frequency Y/N	4/24 (14.3%/85.7%)
Detrusor underactivity frequency Y/N	23/5 (82.1%/17.9%)
Detrusor hypocompliance	
Frequency Y/N	25/3 (89.3%/10.7%)
Storage disorder frequency Y/N	12/16 (42.9%/57.1%)
Emptying disorder frequency Y/N	27/1 (96.4%/3.6%)
Anticholinergic drugs (prescribed) Y/N	14/14 (50%/50%)
Alpha-blocker drugs (prescribed) Y/N	16/12 (57.1%/42.9%)
Bladder-filling sensation category	
- Preserved	11 (39.3%)
- Partially preserved	14 (50%)
- Absent	3 (10.7%)
Emptying method at admission	
- Spontaneous voiding/emptying without catheter	13 (50.0%)
- Intermittent catheterization	7 (26.9%)
- Indwelling catheter	6 (23.1%)
Prescribed emptying method	
(Emptying method at discharge)	
- Spontaneous voiding/emptying without catheter	9 (32.1%)
- Intermittent catheterization	16 (57.1%)
- Indwelling catheter	3 (10.7%)
Normal renal USG Y/N	20/7 (76.9%/23.1%)
Normal bladder USG Y/N	25/1 (96.2-3.8)
Normal renal function tests Y/N	24/1 (96/4)
Normal urine culture Y/N	17/7 (70.8/29.2)
Bacteriuria frequency Y/N	7/17 (70.8-29.2)
Leucocyturia frequency Y/N	5/19 (79.2-20.8)

M: Male; F: Female; Y: Yes; N: No; USG: Ultrasonography; The data are shown as n, (%) or mean±standard deviation.

USG imaging features (p>0.05) except emptying method at admission (p=0.024).

DISCUSSION

In our study, after surgery, 23 of 28 patients (82.1%) had detrusor underactivity, 25 of 28 patients (89.3%) had detrusor hypo-compliance, 27 (96.4%) had emptying disorder, and 14 (50%) had storage disorder and these findings were suggestive of infrasacral neurogenic lower urinary tract dysfunction in this patient population.

Conflicting results have been reported about neurogenic bladder improvement after surgical procedures, with some authors showing significant improvements after surgery, while others have reported poor recovery in detrusor functions after surgical procedures our results are in agreement with Bartolin et al.[8,23,24]

The rates of prescribed drugs for lower urinary tract dysfunction were as follows: alpha blocker (57%), and anticholinergic (50%). Seven of 26 patients (26.9%) had abnormal renal USG findings, which demonstrated the importance of proper and continuous neurogenic bladder management. High rates of renal dysfunction and related anatomic changes due to lower urinary tract problems accompanying lumbar disc diseases have been reported previously.[25]

A disc hernia-related prominent compression to the nerve roots can cause injuries including trophic damage, demyelination and axonal damage. Progressive atrophy of nerve fibers, first involving the sensory fibers, can lead to decreased bladder sensation and detrusor underactivity which may lead to upper urinay tract deterioration.[26] It has been reported that when there is absence of BFS or severe deficit, there is a high risk of upper urinary tract damage.[25,27,28] However, continuous sensorial inputs from the lower urinary tract in patients with normal BFS can protect the urinary tract from the devastating effects of overdistention. Presence of BFS in nearly 90% of our patients appeared as a good finding from this aspect. In the current study, when patients were divided two groups as normal (preserved) BFS group and the abnormal (partially preserved/absence) BFS group, no statistically significant difference was determined between these groups in respect of urodynamic studies, clinical, and renal/bladder USG imaging findings, but the frequencies of bacteriuria and abnormal urine culture were significantly higher in the normal BFS group. Although this finding is difficult to explain, a possible explanation may be continuous post-void residual urine which may promote bacterial colonisation in bladder in normal BFS group because of in-

TABLE 2: Comparison of demographic, clinical, urodynamic, laboratory and imaging features of the patients according to gender, BFS, and PD.

	Gender			BFS			PD		
Variables	**Male (n=16)**	**Female (n=12)**	**p value**	**Normal (n=11)**	**Abnormal (n=17)**	**p value**	**<6 months (n=8)**	**≥6 months (n=20)**	**p value**
Age (years)	56.3±12.2	48.4±12.3	0.106	53±15	52.8±11.4	0.972	52±13.3	53.3±12.7	0.819
Gender (M/F)				4/7	12/5	0.074	5/3	11/9	0.717
PD (months)	23.6±27.6	29.4±27.0	0.585	26.5±27.5	25.8±27.6	0.947	3.3±1.7	35.3±27	0.003
DOF Y/N	2/14	2/10	0.755	1/10	3/14	0.527	1/7	3/17	0.864
DHF Y/N	2/14	1/11	0.724	0/11	3/14	0.140	0/8	3/17	0.246
SDF Y/N	6/10	6/6	0.508	5/6	7/10	0.823	3/5	9/11	0.717
EDF Y/N	1/15	0/12	0.378	0/11	1/16	0.413	1/7	0/20	0.107
Anticholinergic Y/N	9/7	5/7	0.445	5/6	9/8	0.699	4/4	10/10	>0.999
Alpha-blocker Y/N	8/8	8/4	0.378	8/3	8/9	0.180	5/3	11/9	0.717
Emptying method at admission									
- Spontaneous voiding/emptying without catheter	4	9		7	6		3	10	
- Intermittent catheterization	6	1	0.049*	1	6	0.213	0	7	0.024*
- Indwelling catheter	4	2		2	4		4	2	
Prescribed emptying method (EMD)									
- Spontaneous voiding/emptying without catheter	3	6		4	5		2	7	
- Intermittent catheterization	11	5	0.215	7	9	0.337	5	11	0.875
- Indwelling catheter	2	1		0	3		1	2	
Bladder-filling sensation (n)									
- Absent	2	1					1	2	
- Part. preserved	10	4	0.200				3	11	0.701
- Preserved	4	7					4	7	
Normal Renal USG Y/N	9/5	10/2	0.275	7/4	12/3	0.353	4/2	15/5	0.686
Normal Bladder USG Y/N	13/1	12/0	0.345	11/0	14/1	0.382	6/0	19/1	0.576
Normal renal tests Y/N	12/1	12/0	0.327	9/1	15/0	0.211	5/1	19/1	0.069
Normal urine culture Y/N	11/5	9/3	0.717	5/4	13/2	0.028*	3/2	14/5	0.514
Leucocyturia frequency Y/N	2/10	3/9	0.615	3/6	2/13	0.243	2/3	3/16	0.236
Bacteriuria frequency Y/N	2/10	5/7	0.178	5/4	2/13	0.028*	2/3	5/14	0.549

BFS: Bladder filling sensation; M: Male; F: Female; PD: Postoperative duration; DOF: Detrusor overactivity frequency; DHF: Detrusor hypocompliance frequency; SDF: Storage disorder frequency; EDF: Emptying disorder frequency; EMD: Emptying method at discharge; Y: Yes; N: No; USG: Ultrasonography; p value*p<0.05 was considered as statistically significant.

complete emptying according to the emptying method at admission (70% spontaneous voiding/emptying without catheter, 30% intermittent or indwelling catheter). In normal BFS group, incomplete emptying may be expected more frequently than the abnormal BFS group as emptying method at admission were intermittent or indwelling catheter in 62.5% and spontaneous voiding/emptying without catheter in 37.5% in abnormal BFS group. We feel that efforts to decrease post-void residual urine in normal BFS patients can be protective against infections and infection-related urinary problems. Nevertheless, further studies with larger patient populations are required to confirm this outcome.

Other important findings of our study were higher indwelling urethral catheter frequencies at admission observed in male patients and in patients with postoperative duration shorter than 6 months. As longer urethra causes higher urethral voiding pressures in male patients, frequent indwelling urethral catheter use for higher emptying disorder frequency is not surprising. In these patients shifting to spontaneous voiding or to intermittent catheterisation would diminish the side effects of indwelling urethral catheters like urinary tract infection, hematuria, urethral trauma, urethral fistul formation, bladder stones, detrusor hypocompliance, inconvenience due to catheter, etc. The higher indwelling urethral catheter frequencies at admission observed in patients with shorter postoperative duration (<6 months) than patients with longer postoperative duration (≥6 months) can be explained by overlooked or delayed lower urinary tract dysfunction evaluation and management. In our study, indwelling urethral catheter frequency dramatically decreased in this patient subgroup after appropriate lower urinary tract dysfunction evaluation and management.

The present study has some limitations. First, the study was conducted in a single urodynamics laboratory and the sample size was relatively small. Second, the absence of preoperative data limited the ability to make comparisons before and after surgical management. However, we feel that our study is beneficial yet as there are few studies about the urinary tract dysfunction in patients with lumbar and lumbosacral disc herniation surgery whereas there are many studies about urinary tract dysfunction in other spinal disorders.[25,29-31]

CONCLUSION

In conclusion, it can be emphasized that patients with a history of lumbar or lumbosacral disc hernia surgery are at risk of neurogenic bladder, and therefore, follow-up with urodynamic studies, clinical and laboratory tests, and renal system imaging should be an important part of proper management. Furthermore, as higher indwelling urethral catheter frequencies at admission observed in male patients and in patients with short postoperative duration, evaluation of the patients with indwelling urethral catheters as soon as possible and shifting to spontaneous voiding or intermittent catheterisation will diminish the side effects of indwelling urethral catheters in these patients.

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