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The Evaluation of Neurogenic Lower Urinary Tract Dysfunction in Stroke Patients

İnme Hastalarında Nörojenik Alt Üriner Sistem Disfonksiyonunun Değerlendirilmesi

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Öz

Nörojenik alt üriner sistem disfonksiyonu (NAÜSD) inme sonrası sık görülen ve hastaların fonksiyonel durumunu ve yaşam kalitesini olumsuz etkileyen bir durumdur. Bu çalışmada, kronik inmeli hastalarda mesane fonksiyonlarını değerlendirmeyi ve NAÜSD için risk faktörlerini araştırılması amaçlanmıştır. Çalışmaya en az 6 ay önce inme atağı öyküsü olan 71 hasta dahil edildi. Vaka grubu ürodinamik çalışma ile NAÜSD tanısı konan 35 hastadan, kontrol grubu ise herhangi bir üriner şikayeti olmayan 36 hastadan oluşturuldu. Hastaların demografik özellikleri değerlendirildi. Ayrıca hastaların başvuru şikayetleri, idrar öyküleri ve işeme yöntemleri sorgulandı. Üriner yakınmaları olan inmeli hastaların mesane fonksiyonları ürodinamik çalışma raporları ile değerlendirildi. Her iki grup arasında yaş, cinsiyet, eğitim durumu, inme sonrası süre, lezyon tarafı ve lezyon tipi açısından anlamlı fark yoktu (p>0,05). Ürodinamik çalışmalar hastaların %85,7'sinde aşırı aktif detrüsör ve azalmış mesane kapasitesi olduğunu gösterdi. Üriner disfonksiyon lezyon tarafına ve etyolojisine göre anlamlı farklılık göstermedi (p>0,05). Geniş lezyonlu hastalarda üriner disfonksiyon oranı anlamlı olarak daha yüksekti (p=0,019). Geniş enfarktüs, düşük bilişsel düzey ve eşlik eden patolojilerin varlığı NAÜSD için risk faktörleri olarak tanımlanmıştır. NAÜSD tanısında ayrıntılı bir öykü ve videourodinamik değerlendirme önemlidir.

Anahtar Kelimeler: İnme Rehabilitasyonu, Mesane, Ürodinami

Abstract

Neurogenic lower urinary tract dysfunction (NLUTD) is common after stroke, and it is a condition that negatively affects the functional status and quality of life of the patients. This study aimed to evaluate bladder functions and explore the risk factors for NLUTD in chronic stroke patients. Seventy-one patients with a history of stroke attack at least 6 months ago were included in the study. Case group consisted of 35 patients having NLUTD diagnosed by urodynamic study and the control group consisted of 36 patients without any urinary complaints. The demographics of the patients were evaluated. In addition, presenting complaints, urinary histories and voiding methods of the patients were questioned. Bladder functions of stroke patients with urinary complaints were evaluated through urodynamic study reports. There were no significant differences between both groups in terms of age, gender, educational status, time since stroke, lesion side and lesion type (p>0.05). Urodynamic studies revealed overactive detrusor and decreased bladder capacity in 85.7% of the patients. Urinary dysfunction did not show any significant difference (p>0.05) according to lesion side and etiology. The rate of urinary dysfunction was significantly higher (p=0.019) in patients with large lesions. Large infarct size, low cognitive level, and presence of accompanying pathologies were described as risk factors for NLUTD. A detailed history and videourodynamic evaluation are important in the diagnosis of NLUTD.

Keywords: Stroke Rehabilitation, Urinary Bladder, Urodynamics

Introduction

Urinary incontinence and other voiding disorders are common sequelae following stroke. Young age, lacunar infarct, functional independence, cognitive functions, cognitive level, the ability to communicate, and mobility are important factors affecting recovery of urinary incontinence. In contrast, hemiparesis, depression, cognitive disorder, age over 75 years, dysphagia, visual field defects, and large infarcts (cortical plus subcortical involvement) were identified as risk factors for the development of urinary incontinence (1,2). During the early stage of stroke, 65% of these patients may experience voiding dysfunctions, including frequent and urgent urination, urinary incontinence, and inability to void (3). Urinary incontinence is one of the most common problems after stroke and affects one third of the patients in the acute period. It is also known that this condition persists for one year in one-fourth of the patients. This condition is a strong determinant of high mortality rates, and increased disability (4). The incidence of urinary incontinence decreases with time; however, other voiding problems emerge. Voiding dysfunctions not only affect the patient's quality of life and the mortality rate, but also affect the caregiver (5). Urodynamic studies are important in better understanding, improving, and directly helping in bladder management. Neurogenic detrusor overactivity is the most common urodynamic finding after stroke. It is thought that the loss of inhibitory input from higher neurological centers leads to hyperreflexia causing urinary urgency, frequency, and urge incontinence. In addition to neurogenic detrusor overactivity, detrusor underactivity or areflexia may also occur after stroke leading to overflow incontinence. There is a limited number of studies evaluating the type, onset, recovery, and urodynamic findings of post-

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stroke symptoms other than urinary incontinence. Further studies are needed to reveal the most effective bladder treatment strategies in urinary incontinence and to examine post-stroke voiding disorders holistically (5).

Thus, in this study, we aimed to evaluate bladder functions and investigate the risk factors for neurogenic lower urinary tract dysfunction in chronic stroke patients.

Material and Method

The ethics committee approval for this study was received from Dr Sadi Konuk Training and Research Hospital with the decision dated 30.10.2015 and numbered 2015/16/04. There was no conflict of interest.

Seventy-one patients with a stroke history of at least six months were included in the study. The case group consisted of 35 patients whose LUTD was demonstrated by urodynamic studies, while the control group consisted of 36 patients without any urinary complaints.

Male and female stroke patients with a stroke duration of 6 months or more and patients with a first ischemic or hemorrhagic stroke were included in the study. Patients with stroke caused by trauma or tumors, more than one previous cerebrovascular event, urinary complaints before stroke, previous history of urogenital surgery, spinal cord injury (SCI), a prostate volume of >35 ml determined by US, bladder outflow obstruction, poorly controlled diabetes mellitus (DM), other accompanying neurological diseases, anticholinergic or alpha agonist-antagonist medication use, sensory or global aphasia and advanced communication impairment were excluded.

The demographic data, time since stroke, hemiplegic side, dominant hand, etiology of stroke, risk factors for stroke and accompanying pathologies (fecal incontinence, aphasia, dysarthria, dysphagia, hemianopia, etc.), and neurological disorders of the patients were recorded. In addition, the complaints, and urinary histories of the patients were questioned.

The brain lesions of the patients were divided into two groups as small or large lesions based on their first cranial MRI/CT results in the neurology clinic that was consulted a neurologist. The threshold for the differentiation of small and large plaques was defined as 1.5 cm (6). Lesions larger than 1.5 cm were defined as large lesions. In our study, patients describing urinary incontinence were classified as a) urge incontinence, b) reflex voiding, c) stress incontinence, d) overflow incontinence, and e) mixed type. In both groups, the amount of urine that was routinely checked and remained in the bladder after urinating was recorded as post-void residual urine (PVR). The levels of urea and creatinine in addition to the results of complete urine analysis (UA) and urine culture obtained in the routine controls of both groups were recorded. Urodynamic reports were obtained from a urodynamic study with a 6-channel urodynamic monitor (Solar Uro MMS 2003, Enschede, The Netherlands). In urodynamic studies performed with this device, a 7 Fr urethral catheter was used for intravesical pressure measurement and a rectal balloon was used for the measurement of intraabdominal pressure. Two superficial electrodes were placed around the anal sphincter to measure the sphincter activity. Isotonic solution was applied intravesically at a rate of 20 ml/min while the patient was in a sitting position. Videourodynamic study was performed by spontaneously obtaining fluoroscopic images with filling cystometry to detect reflux or space-occupying lesions (stones, stones, tumors, etc.) in the bladder. Contrast material was then added to the filling liquid at a concentration of 20%. Mini Mental Test (MMT) was used to evaluate the cognitive status of the patients. MMT is classified into 5 domains: orientation (10 points), registration (3 points), attention, and calculation (5 points), recall (3 points), and language (9 points). MMT has 11 items with a total of 30 points. In this test, 0-9 points indicate severe cognitive disorder, 10-19 points moderate cognitive disorder, 20-23 points mild cognitive disorder and 24-30 points show normal cognitive function (7).

The descriptive statistics of the data are presented with mean, standard deviation, median, minimum, maximum, frequency and percentage values. The distribution of the variables was tested using the Shapiro-Wilk Test. The Mann-Whitney U-test was used to analyze the quantitative data. The qualitative data were analyzed with Chi-square test. SPSS 22.0 software was used for the analyses. Significance was defined as $p<0.05$.

Results

A total of 71 stroke patients under follow-up in a tertiary rehabilitation hospital were enrolled in the study. Thirty-five patients with urinary complaints and videourodynamic report were included in the case group, while 36 patients without urinary complaints were included in the control group. There was no significant difference between the case and control group with respect to age (in the case group age median was 65 years, min-max=45-81 years and in the control group the age median was 64 years, min-max=30-88 years; p=0.545), gender distribution (p=0.701), stroke duration (in the case group, the stroke duration median was 10 months, min-max=6-36 months and in the control group, the stroke duration median was 13 months, min-max=6-32 months; p=0.335), marital status distribution, educational status and profession distribution (p=296, p=0.686, p=1.000, respectively). The rate of urinary dysfunction did not differ significantly in terms of lesion side and etiology (p=1.000, p=0.102,

respectively). Urinary dysfunction was significantly higher in patients with large lesions (p=0.019) (Table 1). There was no significant difference in the stroke risk factors (Age (>65years), hypertension, diabetes mellitus, hyperlipidemia, cardiac disease, heredite, smoking) (p=0.062, p=0.351, p=0.561, p=0.360, p= 0.559, p=1.000, p=0.296, respectively) (Table 2). The rate of the concomitant pathologies (speech disorders, neglect, dysphagia and others) were significantly higher in the case group compared to the control group (p=0.003). The rate of fecal incontinence was significantly higher in the case group compared to the control group (p=0.011). The rate of Brocca type aphasia, dysarthria, dysphagia, hemianopia, central type facial paralysis, upward gaze palys did not differ significantly in both groups (p=0.711, p=0.533, p=0.107, p=0.493, p=0.493, p=1.000, respectively) (Table 3). Urinary complaints were recorded and the frequency of complaints according to intensity was as follows: urinary incontinence, frequency, difficulty when urinating, hesitancy, furcation while urinating, inability to urinate. Of the patients with urinary incontinence, 55% described urge incontinence, 42% reflex urination, and 3% overflow incontinence. In addition, 23% of the patients described frequent urination, 17% described difficulty urinating, 9% described sudden urge, 6% described bifurcation urine, and 3% described nocturia (Table 4). The rate of asymptomatic bacteriuria in urine culture in the case group was significantly higher than in the control group (p=0.025) (Table 5). Prostate volume measurements performed with urinary ultrasound in male patients and residual urine volume results in both genders did not differ significantly in both groups (p=0.806). According to the urodynamic data of the case group; mean maximum bladder capacity was 355 mL, mean maximum abdominal pressure was 9 cm H_20, mean maximum detrusor pressure was 58 cm H_20, and mean maximum vesical pressure was 73 cm H_20.

Table 1. Demographic data, stroke side and etiology ratio in both groups

		Case Group		Control Group		p
		n	%	n	%	
Sex	Woman	22	63	20	56	0.701
	Man	13	37	16	44	
Marital Status	Married	29	82.9	25	69.4	0.296
	Single or Widow	6	17.1	11	30.6	
Education Status	Not Literate	11	31.4	10	27.8	0.686
	Literate / Primary education	19	54.3	18	50.0	
	Secondary education or higher	5	14.3	8	22.2	
Profession	Housewife / Pensioner	32	91.4	32	88.9	1.000
	Worker / Civil servant	3	8.6	4	11.1	
Stroke Side	Right	15	43	15	42	1.000
	Left	20	57	21	58	
Etiology	Ischemic	26	74	33	92	0.102
	Hemorrhagic	9	26	3	8	
Lesion size	Large	17	48.6	7	19.4	0.019
	Small	18	51.4	29	80.6	

The blood urea nitrogen (BUN) level was significantly higher in the case group compared to the control group (p=0.039). The creatinine level did not differ significantly in both groups (p=0.682) (Table 6). MMT score was significantly lower in the case group (p=0.014). There was no statistically significant difference between the two groups in terms of Brunnstrom upper extremity score (p=0.169), and lower extremity score (p=0.465) hand score (p=0.102) (Table 7).

Discussion

It is important to identify the risk factors for urinary dysfunction in stroke patients since urinary dysfunction is a common problem in these patients. After a stroke, 43.5% of the patients have urinary incontinence in the first three months, and 37.7% in the first year. In addition, urge incontinence is the most common type of incontinence (8). Post-stroke neurogenic lower urinary tract dysfunction was associated with the presence of large infarct, low cognitive level, and the presence of accompanying pathologies. No association was found between neurogenic lower urinary tract dysfunction and the side, location, and etiology of the lesion. On the other hand, in their prospective study on 151 stroke patients, Borrie et al. reported that dysphagia and visual field defects in the early stage were associated with urinary incontinence (9).

In a study conducted by Thomas et al. investigating factors associated with incontinence in patients with urinary incontinence, 12 studies from 1982 to 2007 were systematically reviewed in the Cochrane Database and urinary incontinence was found to be associated with advanced age, cognitive impairment, and aphasia. Mizrahi et al. in their study evaluated bladder management and functional outcomes in elderly stroke patients and found that urinary incontinence was associated with cognitive

dysfunction in chronic stroke patients (11). In a study by Gelber et al., incontinence was associated with large infarct size, aphasia and cognitive impairment in 51 ischemic patients. However, no relationship was found between incontinence and age, gender, or lesion side (2). In a study by Kim et al., it was reported that the most important factor for the development of urinary incontinence after stroke was the size of the lesion, but not the location (12). Unlike our study, urinary dysfunction was found to be associated with dysphagia, aphasia, and visual field defects in the literature. The presence of additional pathologies accompanying stroke such as dysphagia, aphasia and visual field defect is an indicator of poor prognosis and is more common in patients with large lesions who have a long intensive care unit stay (13). In a study conducted in South China, risk factors associated with poststroke urinary incontinence were hemorrhagic stroke, parietal lobe lesion, chronic cough, aphasia and poststroke depression. However, the relationship between stroke type, lesion, and type of bladder voiding was not clear (14). Considering the studies showing that urinary dysfunction is related to the extent of the lesion rather than its location, it can be concluded that dysphagia, aphasia, and visual field defects, which are more common in patients with large lesions, may also have affected urinary function. Our study also found that urinary dysfunction was associated with lesion width and not the localization, side or etiology of the lesion. The fact that we could not find any association between urinary dysfunction and dysphagia, aphasia, or visual field defect may be due to the lower number of patients enrolled in our study. In a study conducted by Uraloğlu et al. examining the bowel functions of 112 stroke patients, it was reported that fecal incontinence was associated with lack of movement, functional insufficiency, difficulty getting to the bathroom, cognitive impairment, communication difficulties and inadequate care (15). In our study, the rate of fecal incontinence was significantly higher in the case group. The cognitive status of the patients was significantly worse in the study group. Clinical studies and these data suggest that the high rate of fecal incontinence may be due to decreased cognitive level.

Table 2. Risk factors for stroke in both groups

	Case Group (n=35)		**Control Group (n=36)**		**p**
	n	**%**	**n**	**%**	
Age (>65yrs)	26	74	18	50	0.062
Hypertension	26	74	22	61	0.351
Diabetes mellitus	15	43	12	33	0.561
Hyperlipidemia	10	29	6	17	0.360
Cardiac disease	14	40	11	31	0.559
Heredite	5	14	6	17	1.000
Smoking	6	17	11	31	0.296

Table 3. Concomitant pathologies in both groups

	Case Group (n=35)		**Control Group (n=36)**		**p**
	n	**%**	**n**	**%**	
Presence of accompanying pathology	25	71	13	36	0.003
Brocca type aphasia	7	20	5	14	0.711
Dysarthria	10	29	7	19	0.533
Dysphagia	5	14	1	3	0.107
Hemianopia	1	3	0	0	0.493
Fecal incontinence	6	17	0	0	0.011
Santral facial paralysis	1	3	0	0	0.493
Upward gaze palys	1	3	1	3	1.000

The different types of post-stroke urinary incontinence that have been well-described include detrusor overactivity and urge incontinence, detrusor underactivity and overflow incontinence, functional incontinence, impaired awareness incontinence, and exacerbation of preexisting stress incontinence (16). In our study urinary complaints of the patients were urinary incontinence, urinary frequency, dysuria, urinary urgency, urinary bifurcation and inability to void with decreasing order of frequency. Of the patients with urinary incontinence, 55% described urge incontinence, 42% reflex voiding, and 3% overflow incontinence. Based on the symptomatic characterization of incontinence, reflex voiding and urge incontinence suggest detrusor hyperactivity, while stress incontinence and overflow incontinence indicate sphincter insufficiency and detrusor underactivity, respectively (17). Urinary symptoms were consistent with the urodynamic findings in our study.

Table 4. Urinary complaints described in the case group (n=35)

	Case Group	
	n	**%**
Urinary incontinence	29	83
Urge incontinence	16	55
Reflex urinating	12	42
Stress incontinence	0	0
Overflow incontinence	1	3
Mixed type incontinence	0	0
Difficulty in urinating	6	17
Frequent urination	8	23
Nocturia	1	3
Bifurcation urine	2	6
Sudden urge	3	9

In a prospective study of 60 patients, neurogenic detrusor overactivity was found in patients with frontoparietal and internal capsule infarction, while normal urodynamic studies were found in patients with temporooccipital lobe infarction. In addition, in their series, 47% of the patients had urinary retention, mainly caused by detrusor areflexia (75%). Detrusor areflexia was more common in hemorrhagic infarctions (85%). Although most cortical and internal capsular lesions caused detrusor overactivity, all cerebellar infarcts resulted in detrusor areflexia (18). In a study by Lee et al. 127 patients undergoing urodynamic examination due to post-stroke urinary symptoms were divided into 3 groups as detrusor overactivity (DO), detrusor overactivity with impaired contractility (DOIC) and detrusor underactivity (DU) and the urodynamic data were compared. Total bladder capacity was 219.15±98.30 mL in the DO group, 330.25±115.75 mL in the DOIC group, and 486.00±111.48 mL in the DU group. Post void residual (PVR) was 22.64±20.85 mL in the DO group, 146.87±95.09 mL in the DOIC group, and 425.33±136.70 mL in the DU group. It was reported that total bladder capacity and PVR may provide useful information for the treatment of patients who are unable to undergo urodynamic examination (19). In our study, urodynamic studies revealed decreased maximum bladder capacity, increased detrusor leak point pressure (det-LPP) and decreased post void residual (PVR), consistent with the DO groups in the literature. In their study on 188 stroke patients under treatment in the stroke rehabilitation unit, Kim et al. reported that 39.4% of the patients had urinary tract infection (UTI) and causative factors for UTI included low cognitive function, low functional level, and high residual urine volume (20). In our study, there were more cases of UTI in the case group when compared to the control group and UTI was associated with low cognitive function, neurogenic lower urinary tract dysfunction and diaper use. Blood urea nitrogen (BUN) is a biochemical test used to assess renal function and protein metabolism. The rate of urea production is not constant. It increases with a high-protein diet, older age, acute or chronic intrinsic renal diseases, postrenal obstruction, renal failure and enhanced tissue breakdown due to hemorrhage, trauma, or glucocorticoid therapy (21,22). Also, in our study, BUN level was significantly higher in the case group. A higher number of patients over 65 years of age and worse cognitive status in the case group may have affected the fluid intake of the patients, leading to an increase in the BUN level. In a study on stroke patients, high blood urea nitrogen / creatinine levels were attributed to dehydration (23).

Table 5. Urine analysis and urine culture results in both groups

		Case Group (n=35)		Control Group (n=36)		p
		n	**%**	**n**	**%**	
Urine Analysis	Leukocyte-nitrite (+)	11	31	5	14	0.138
	Normal	24	69	31	86	
Urine Culture	Bacterium (+)	5	14	0	0	0.025
	Sterile	30	86	36	100	

Table 6. The mean serum BUN / Creatinine level, prostate volume, residual urine of both groups and urodynamic data of the case group

	Case Group (n=35)		Control Group (n=36)		p
BUN (mg/mL)	36.3	(20.0-104.0)	31.5	(23.0-65.9)	0.039
Creatinine (mg/mL)	0.8	(0.5-1.5)	0.8	(0.7-1.3)	0.682
Prostate volume (mL)	29.8	(19.0-35.0)	31.5	(17.0-35.0)	0.806
Residue urine (mL)	10.0	(0-200.0)	0	(0-400.0)	0.136
Urodynamic data					
Max Bladder Capacity (mL)	375.2	±118.1			
Max Abdominal Pressure (cm H_20)	9.5	±7.1			
Max Detrusor Pressure (cm H_20)	58.0	(22.0-249.0)			
Max Vesical Pressure (cm H_20)	72.5	(35.0-262.0)			

However, the significantly higher urea level found in the neurogenic lower urinary tract dysfunction group suggests that attention should be paid to the upper urinary tract.

In our study, age over 65 years, large infarct, low cognitive level, and the presence of accompanying pathologies were identified as the risk factors for neurogenic lower urinary tract dysfunction. A detailed history and videourodynamic evaluation are important in the diagnosis of neurogenic lower urinary tract dysfunction. Urinary complaints are a guide for the evaluation of urodynamic data. In our study, 55% of the patients described urge incontinence, 42% reflex voiding, and 3% overflow incontinence. Consistently, the videourodynamic data of the patients were found to be consistent with overactive bladder. However, it would be incorrect, to make a diagnosis and plan treatment based on the symptoms since symptoms may not always correlate with the objective urodynamic findings. Urinary dysfunction was found to be associated with lesion width and not with the localization, side, or etiology of the lesion. UTI was associated with overactive bladder, low cognitive function, and diaper use. High urea levels were attributed to dehydration. However, high urea levels suggest that attention should be paid to the upper urinary tract.

Table 7. The Brunnstrom scores and MMT points of both groups

	Case Group (n=35)		Control Group (n=36)		p
Brunnstrom upper extremity	2	(1-6)	2	(1-6)	0.169
Brunnstrom lower extremity	3	(1-6)	3	(1-6)	0.465
Brunnstrom hand	2	(1-6)	1	(1-6)	0.102
MMT*	23.0	(4.0-30.0)	27.0	(12.0-30.0)	0.014

*Mini Mental Test

In conclusions; neurogenic lower urinary tract dysfunction is one of the common complications of stroke. It is an important social problem that reduces quality of life. Therefore, rapid diagnosis and early onset of bladder rehabilitation are required. Knowledge of the risk factors for neurogenic lower urinary tract dysfunction is important in early diagnosis.

Ethics Committee Approval: The ethics committee approval for this study was received from Dr Sadi Konuk Training and Research Hospital with the decision dated 30.10.2015 and numbered 2015/16/04.

References

1. Myint PK, Vowler SL, Redmayne O, ve ark. Cognition, continence and transfer status at the time of discharge from an acute hospital setting and their associations with an unfavourable discharge outcome after stroke. Gerontology. 2008;54(4):202-9.
2. Gelber DA, Good DC, Laven LJ, ve ark. Causes of urinary incontinence after acute hemispheric stroke. Stroke. 1993;24(3):378-82.
3. Kim TG, Chun MH, Chang, MC ve ark. Outcomes of drug-resistant urinary retention in patients in the early stage of stroke. Ann Rehabil Med. 2015;39(2):262-7.
4. Mehdi Z, Birns J, Bhalla A ve ark. Post-stroke urinary incontinence. Int J Clin Pract Suppl. 2013;67(11):1128-37.
5. Linsenmeyer TA. Post-CVA voiding dysfunctions: clinical insights and literature review. NeuroRehabilitation. 2012;30(1):1-7.
6. Fisher M. Lacunar strokes and infarcts A review. Neurology. 1982; 32(8):871-6.
7. Güngen C, Ertan T, Eker E, ve ark. Validity and reliability of Standardized Mini Mental Test in the slight dementia diagnosis in the Turkish society. Turk Psikiyatri Derg. 2002;13(4):273-81.
8. McKenzie P, Badlani GH. The incidence and etiology of overactive bladder in patients after cerebrovascular accident. Curr Urol Rep. 2012;13(5):402-6.
9. Borrie MJ, Campell AJ, Caradoc-davies TH, ve ark. Urinary incontinence after stroke: a prospective study. Age and ageing. 1986;15(3):177-81.
10. Thomas L, Cross S, Barrett J, ve ark. Treatment of urinary incontinence after stroke in adults. Cochrane Database Syst Rev. 2008; 23(1):CD004462.
11. Mizrahi EH, Waitzman A, Arad M, ve ark. Bladder management and the functional outcome of elderly ischemic stroke patients. Arch Gerontol Geriatr. 2011;53(2):e125-8.
12. Kim TG, Yoo KH, Jeon SH, ve ark. Effect of dominant hemispheric stroke on detrusor function in patients with lower urinary tract symptoms. Int J Urol. 2010;17(7):656-60.
13. Horner J, Brazer SR, Massey EW. Aspiration in bilateral stroke patients: A validation study. Neurology 1993;43(2):430-3.
14. Cai W, Wang J, Wang L, ve ark. Prevalence and risk factors of urinary incontinence for post-stroke inpatients in Southern China. Neurourol Urodyn. 2015;34(3):231-5.
15. Uraloglu G, Selçuk B, Kurtaran A, ve ark. Assessment of the bowel dysfunctions in stroke patients. Turk J Geriatr. 2014;17(4):331-7.
16. Panfili Z, Metcalf M, Griebling TL. Contemporary Evaluation and Treatment of Poststroke Lower Urinary Tract Dysfunction. Urol Clin North Am. 2017;44(3):403-14.
17. Ghoniem G, Stanford E, Kenton K, ve ark. Evaluation and outcome measures in the treatment of female urinary stress incontinence: International Urogynecological Association (IUGA) guidelines for research and clinical practice. Int Urogynecol J Pelvic Floor Dysfunct. 2008;19(1):5-33.
18. Burney TL, Senapati M, Desai S, ve ark. Acute cerebrovascular accident and lower urinary tract dysfunction: a prospective correlation of the site of brain injury with urodynamic findings. J Urol 1996;156(5):1748-50.
19. Lee SH, Lee JG, Min GE, ve ark. Usefulness of total bladder capacity and post void residual urine volume as a predictor of detrusor overactivity with impaired contractility in stroke patients. Exp Ther Med.2012;4(6):1112-6.
20. Kim BR, Lim JH, Lee SA, ve ark. The relation between postvoid residual and occurrence of urinary tract infection after stroke in rehabilitation unit. Ann Rehabil Med. 2012;36(2):248-53.
21. Inker LA, Perrone RD. Assessment of kidney function. In: Sterns RH, Forman JP, eds. Available from: URL: https://www.uptodate.com/contents/assessment-of-kidney-function accessed october 2017.

22. Sherman DS, Fish DN, Teitelbaum I. Assessing renal function in cirrhotic patients: problems and pitfalls. Am J Kidney Dis. 2003;41(2):269-78.

23. Schrock JW, Glasenapp M, Drogell K. Elevated blood urea nitrogen/creatinine ratio is associated with poor outcome in patients with ischemic stroke. Clin Neurol Neurosurg. 2012;114(7):881-4.