Am J Transl Res 2026;18(1):359-366
www.ajtr.org /ISSN:1943-8141/AJTR0169760

Original Article

Urodynamic patterns as key predictors of prognosis in post-stroke urinary incontinence: a retrospective study

Xinyang Yu[1*], Yu'nan Che[2*], Wenjing Ping[1], Zhide Li[1], Yingwei Zheng[1], Yunyun Li[1], Yafeng Che[3], Jing Xu[1]

[1]Department of Neurology, Ma'anshan People's Hospital, Ma'anshan 243000, Anhui, China; [2]Department of Urology, Ma'anshan People's Hospital, Ma'anshan 243000, Anhui, China; [3]Department of Chemoradiotherapy for Gastrointestinal Tumors, Changchun Guowen Hospital, Changchun 130000, Jilin, China. [*]Equal contributors.

Received November 3, 2025; Accepted December 11, 2025; Epub January 15, 2026; Published January 30, 2026

Abstract: Objective: To investigate the urodynamic risk factors and prognosis of post-stroke urinary incontinence (PSUI). Methods: The data from 100 stroke patients admitted to our hospital from January 2019 to March 2025 were retrospectively analyzed. According to whether urinary incontinence occurred after treatment, they were divided into urinary incontinence and normal groups, including 42 cases in the urinary incontinence group and 58 cases in the normal group. The general data and treatment-related indicators of the two groups were compared. Univariate and multivariate analysis were used to analyze the influencing factors of urinary incontinence after stroke and establish a predictive model. Finally, the short-term prognosis and influencing factors for patients with urinary incontinence were analyzed. Results: The average age, hematoma size and National Institutes of Health Stroke Scale (NIHSS) score of patients in the urinary incontinence group were significantly higher than those of the normal group. The lesion site analysis showed that the frontal lobe involvement rate was 59.5% in the incontinence group and 25.9% in the control group. The rate of thalamic involvement was 47.6% in the study group and 19.0% in the control group. The incidences of aphasia, cerebral hemorrhage, multiple stroke, female sex and diabetes were higher in the incontinence group. Multivariate analysis identified the following independent risk factors for PSUI: NIHSS score, female sex, frontal lobe lesions, thalamic lesionsand diabetes. The predictive model worked well incorporating these factors. Conclusion: The occurrence of urinary incontinence after stroke was related to the baseline data of patients. Among them, NIHSS score, female sex, frontal and thalamic lesions, and diabetes were influencing factorsfor urinary incontinence after stroke in patients, while NIHSS score, female sex, and diabetes were influencing factors for urinary incontinence persistence. In clinical practice, targeted intervention should be carried out in combination with patient data to reduce the incidence of urinary incontinence after stroke.

Keywords: Stroke, urinary incontinence, influencing factors, prediction efficiency, short-term outcome

Introduction

Stroke is a brain injury caused by acute cerebrovascular events, including cerebral infarction and cerebral hemorrhage [1, 2]. With the advent of an aging society, lifestyle and diet changes and environmental changes, the global incidence of stroke is increasing every year. It has become a major public health threat, putting pressure on patients and society [3, 4].

Stroke-related complications, including somatic symptoms, motor and sensory abnormalities, are relatively well studied. However, the study of urinary incontinence after stroke, a common complication, is relatively insufficient [5, 6]. Urinary incontinence after stroke occurs when the nervous system is damaged and the brain loses control of the bladder, resulting in uncontrolled spontaneous urinary incontinence. It has been confirmed that urinary incontinence after stroke not only affects the rehabilitation process and subsequent life and work of patients, but also brings a specific psychological burden to patients and delays the recovery of their social roles [7, 8]. Studies have shown that early diagnosis and treatment of patients with urinary incontinence after stroke can significantly improve their prognosis, indicating that active and effective early identification of urinary incontinence after stroke is important [9]. Based on this theory, this study retrospectively analyzed the treatment data of

https://doi.org/10.62347/ZBOB8621

patients with urinary incontinence after stroke in our hospital, and explored the influencing factors for urinary incontinence after stroke, in order to provide a theoretical basis for improving the prognosis.

Materials and methods

Basic information

The data of 100 stroke patients admitted to our hospital from January 2019 to March 2025 were retrospectively analyzed. According to whether urinary incontinence occurred after treatment, the patients were divided into urinary incontinence group and normal group. Urinary incontinence is diagnosed as uncontrolled urinary loss, decreased or loss of urinary inhibition, and symptoms such as frequent urination and urgency. Inclusion criteria: 1. Patients with stroke diagnosis in line with relevant guidelines [10]; 2. 18-80 years old; 3. First stroke; 4. Cerebrovascular accident received conventional treatment; 5. Complete clinical data. Exclusion criteria: 1. A history of urinary incontinence; 2. Taking drugs that affect urination; 3. Male prostate dysfunction with urinary dysfunction; 4. Patients with obvious organ dysfunction, such as cardiopulmonary dysfunction; 5. Patients with incomplete clinical data. This study was approved by the Ethics Committee of our hospital (Ethics No.: KYLL-2024-0078).

Treatment

Both groups of patients received conventional drug treatment during treatment, including: Neuroprotection: Neuroprotective agents such as edaravone (an antioxidant), mouse nerve growth factor or brain protein hydrolysate were given to promote nerve repair and functional recovery. Improving cerebral circulation: Drugs that improve cerebral microcirculation and metabolism, such as butylphthalide or vinpocetine, are used to increase cerebral blood flow. Blood pressure control: According to the patient's condition, we used angiotensin converting enzyme inhibitors (ACEIs), such as perindopril, or calcium channel blockers (CCBs), such as amlodipine, to control blood pressure within the target range (e.g. < 140/90 mmHg). Lipid regulation and plaque stability: Statins, such as atorvastatin or rosuvastatin, are routinely used to reduce low-density lipoprotein cholesterol (LDL-C) levels and have anti-inflammatory effects, stabilizing and even reversing atherosclerotic plaque [11].

Data collection

The general information of the patients was obtained by consulting the electronic system, including baseline data, liver and kidney function, lesion location, inflammatory factor changes, and National Institutes of Health Stroke Scale (NIHSS) score.

The differences between the baseline data of the two groups were compared, and the predictive model was established by using the difference factors.

The patients were followed up for three months to observe the recovery of urinary incontinence and analyze the persistent independent risk factors.

Statistics

SPSS 23.0 statistical software was used for analysis. The measured data of the two groups of patients were expressed as 'Mean ± SD'. The two groups were independent, normal, and equal in variance. Paired t test was used for intra-group comparison, and independent t test was used for inter-group comparison. Counted data were compared by chi-square test [n (%)]. Multivariate analysis was performed using multivariate logistic regression analysis. A predictive model of urinary incontinence after stroke was established, and the efficacy of the model was evaluated by ROC curve. $P < 0.05$ was considered significant.

Results

Comparison of baseline data between the two groups of patients

There was no significant difference in body mass index, hypertension, smoking history, or drinking history between the urinary incontinence group and the control group (all $P > 0.05$). However, the age, female ratio, prevalence of diabetes, NIHSS score hematoma volume, frontal lobe and thalamus lesions, accompanied by aphasia, cerebral hemorrhage and the number of strokes in the urinary incontinence group were significantly higher than those in the control group. See **Table 1** for details.

Table 1. Comparison of baseline data between the two groups of patients

Project	Urinary incontinence group (n = 42)	Control group (n = 58)	t/χ²	*P*-value
Age (years)	68.5 ± 8.2	63.1 ± 9.5	2.984	0.004
Body mass index (kg/m²)	24.14 ± 3.05	24.82 ± 2.70	-1.232	0.221
Female sex	28 (66.7%)	25 (43.1%)	5.556	0.018
hypertension	30 (71.4%)	36 (62.1%)	0.981	0.322
diabetes	16 (38.1%)	12 (20.7%)	3.945	0.047
Smoking history	15 (35.7%)	25 (43.1%)	0.552	0.458
Drinking history	12 (28.6%)	20 (34.5%)	0.393	0.531
NIHSS score	10.53 ± 3.14	7.24 ± 2.82	5.576	< 0.001
Hematoma size (mL)	28.63 ± 10.52	18.31 ± 8.70	5.429	< 0.001
Frontal lobe and thalamic lesions	35 (83.3%)	35 (60.3%)	6.240	0.012
With aphasia	20 (47.6%)	15 (25.9%)	5.040	0.025
Cerebral hemorrhage	25 (59.5%)	20 (34.5%)	6.250	0.012
Number of strokes ≥ 2	10 (23.8%)	5 (8.6%)	4.590	0.032

NIHSS: National Institutes of Health Stroke Scale.

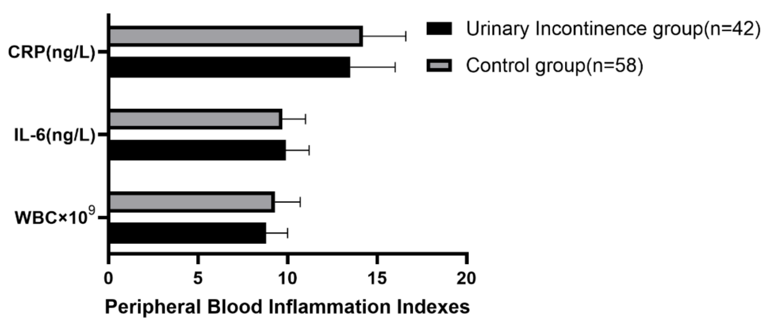

Figure 1. Comparison of inflammatory factors between the two groups. C-reactive protein (CRP), interleukin-6 (IL-6), white blood cells (WBC).

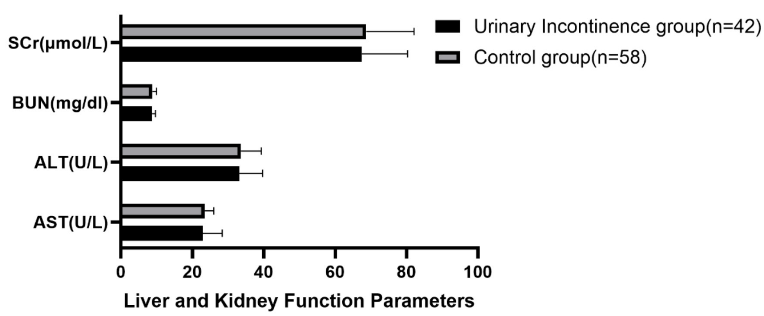

Figure 2. Comparison of liver and kidney function indicators between the two groups of patients. Serum creatinine (SCr), blood urea nitrogen (BUN), alanine aminotransferase (ALT), aspartate aminotransferase (AST).

Comparison of inflammatory factors between the two groups of patients

This study examined the levels of peripheral blood inflammatory markers in the two groups of patients. The results showed that there were no significant differences in CRP, IL-6 and WBC between the urinary incontinence group and the control group (all P > 0.05). Results are shown in **Figure 1**.

Comparison of liver and kidney function between the two groups

The liver and kidney function indexes of the two groups were detected and compared. As shown in **Figure 2**, there were no significant differences in Scr, BUN, ALT or AST between the urinary incontinence group and the control group (all P > 0.05).

Comparison of social support between the two groups of patients

A social support rating scale was used to evaluate the social support level of the two groups of patients. The results showed that there was no significant difference in the total score of social support between the urinary incontinence group and the control group. Results are shown in **Table 2**.

Table 2. Comparison of Social Support Scores between the Two Groups

Project	Urinary incontinence group (n = 42)	Control group (n = 58)	Statistics	*P*-value
Total social support score	38.53 ± 6.20	39.82 ± 7.14	t = -0.983	0.328
Total score of objective support	9.16 ± 2.52	9.67 ± 2.83	t = -0.939	0.350
Total score of subjective support	22.35 ± 4.10	23.04 ± 4.62	t = -0.802	0.425
Support utilization	7.14 ± 1.82	7.25 ± 1.94	t = -0.268	0.789

Table 3. Variable assignment

Variable	Assignment
NIHSS score	Original value
Female sex	0 = yes; 1 = no
diabetes	0 = yes; 1 = no
Frontal lobe and thalamic lesions	0 = yes; 1 = no

NIHSS: National Institutes of Health Stroke Scale.

Multifactorial analysis of urinary incontinence after stroke

Multivariate logistic regression analysis was performed on the significant factors found by univariate analysis. 5 factors independently predicted the risk of urinary incontinence after stroke: higher NIHSS score, female sex, frontal lobe lesions, thalamic lesions, and diabetes.

Among these factors, the risk of frontal lobe lesions was the highest, with the risk of urinary incontinence almost quadrupled, followed by thalamic lesions and female sex. Diabetes moderately increased the risk of urinary incontinence, and for every 1 point increase in NIHSS score, the risk of urinary incontinence increased by 24% (OR 1.240). The specific results are shown in **Tables 3**, **4**.

Predictive performance by ROC analysis for post-stroke urinary incontinence

To develop a predictive model for post-stroke urinary incontinence, variables significant by univariate analysis (including NIHSS score, gender, frontal and thalamic lesions, and diabetes) were incorporated into a multivariate logistic regression. The model demonstrated strong performance across multiple metrics. ROC analysis revealed an area under the curve of 0.856 (95% CI: 0.746-0.956), indicating excellent discriminatory power (**Figure 3**). Good calibration was confirmed by a non-significant Hosmer-Lemeshow test result (x^2 = 9.239, P = 0.315). Furthermore, the model exhibited robust capability in risk classification (**Figure 4**).

Establishment and evaluation of a logistic regression equation for factors affecting urinary incontinence after stroke

Substituting the multivariate analysis results in **Table 4** into the equation, the resulting logistic regression predictive model was: P = 1/(1 + ex) [X = -5.201 + (0.215 × NIHSS score) + (1.025 × 1) + (1.362 × 1) + (1.148 × 1) + (0.863 × 1)]. The predicted probability of 0.5 was used as the intercept point, and patients with P ≥ 0.5 were considered likely to have urinary incontinence. Substituting the sample data back into the above equation, the model demonstrated an accuracy of 90.0%, a specificity of 93.1%, and a sensitivity of 85.7% for predicting post-stroke urinary incontinence (see **Table 5** for details).

Analysis of short-term prognosis and influencing factors for urinary incontinence after stroke

The comparison of baseline data between the two groups showed that there were significant differences in the proportion of women (66.7% vs 11.1%, χ^2 = 13.381, P < 0.001), the prevalence of diabetes (58.3% vs 11.1%, χ^2 = 10.267, P = 0.001) and NIHSS score (13.24 ± 2.52 vs 7.53 ± 2.21, t = 7.823, P < 0.001) (**Table 6**).

Multivariate logistic regression analysis further confirmed that NIHSS score (OR 1.328, 95% CI 1.176-1.500, P = 0.031), female sex (OR 6.703, 95% CI 3.023-2.268, P = 0.021) and diabetes (OR 7.109, 95% CI 1.404-3.770, P = 0.018) were independent risk factors for the persistence of urinary incontinence after stroke (**Table 7**). Among them, diabetes (OR 7.109) and women (OR 6.703) had the highest risk. For every 1 point increase in NIHSS score, the risk of urinary incontinence continued to increase by about 32.8%.

Table 4. Multivariate analysis of urinary incontinence after stroke

Influencing factors	β value	Standard error	Wald χ^2 value	OR value	95% CI	*P* value
NIHSS score	0.215	0.045	22.778	1.240	(1.135-1.355)	< 0.001
Female sex	1.025	0.392	6.832	2.787	(1.292-6.011)	0.009
Frontal lobe lesions	1.362	0.421	10.465	3.904	(1.711-8.908)	0.001
Thalamic lesions	1.148	0.447	6.595	3.152	(1.312-7.574)	0.010
diabetes	0.863	0.385	5.023	2.370	(1.115-5.038)	0.025

NIHSS: National Institutes of Health Stroke Scale.

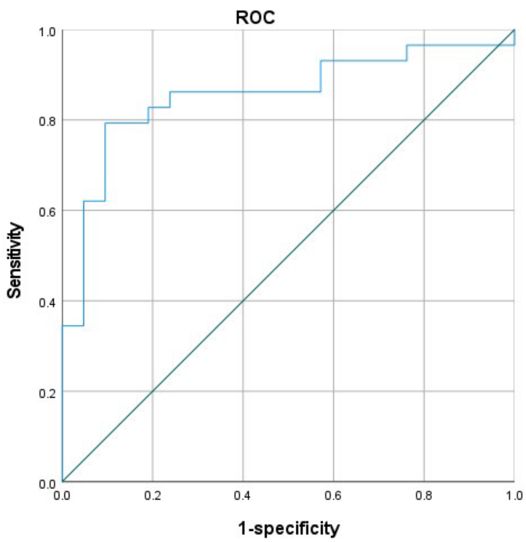

Figure 3. ROC curve.

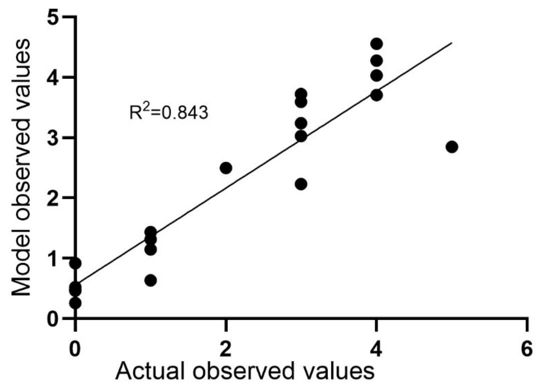

Figure 4. Urinary incontinence model calibration graph (Calibration Plot).

Discussion

Studies have confirmed that post-stroke urinary incontinence is the most common functional disability after stroke, mainly because the nervous system loses conscious control of the bladder after stroke, resulting in spontaneous urination [12, 13]. Epidemiologic surveys have shown that the incidence of urinary incontinence in the acute phase of stroke worldwide is more than 50% [14]. Urinary incontinence not only causes organ damage such as urinary tract infection and skin injury, but also causes psychological problems such as embarrassment, anxiety, depression and social isolation, which affects the rehabilitation process of patients and increases the burden to patients and society. Therefore, early identification of high-risk groups after stroke, in-depth discussion of its influencing factors, and establishment of predictive models provide a theoretical basis for improving the overall diagnosis and treatment level of stroke patients [15, 16].

Previous literature has shown that post-stroke urinary incontinence is associated with baseline patient characteristics [17]. NIHSS score, female, frontal and thalamic lesions, and diabetes were the influencing factors of urinary incontinence after stroke [18]. Specifically, NIHSS score is a core independent risk factor for urinary incontinence after stroke. Higher NIHSS scores usually indicate more extensive brain injury or more involvement of key neural centers, which can significantly disrupt the integrity of the network. Damage to the higher centers (mainly the prefrontal cortex) that regulate bladder storage and urination weakens their inhibitory effects on the brainstem urinary center, leading to unstable bladder overcontraction and urinary incontinence. The NIHSS score can not only effectively evaluate the overall severity of stroke, but also be a powerful objective indicator for predicting urinary dysfunction [19, 20]. The risk of female urinary incontinence is closely related to its unique physiological and anatomical structure. Women's urethra is short and straight, and their pelvic floor muscles are inherently weaker than men, resulting in worse compensatory urination. In addition, previous pregnancies and vaginal births can

Table 5. Comparison of predicted variance of urinary incontinence in stroke patients with actual samples

Actual urinary incontinence	Predicting urinary incontinence		Total
	None	Have	
none	54	6	59
have	4	36	41
total	58	42	100

damage and weaken women's pelvic floor support structures. Finally, the decrease of estrogen level in postmenopausal women leads to the atrophy of urethral mucosa and the decrease of closure ability, which is also an important cause of urinary incontinence. The frontal lobe, especially the prefrontal lobe, is the highest center for controlling urination and participates in active inhibition of urination. Therefore, the damage of stroke to the frontal lobe will damage this active inhibition, resulting in weakened or absent urinary inhibition reflex, resulting in urinary incontinence. Chronic hyperglycemia can cause diabetic peripheral neuropathy and damage the autonomic nervous system that dominates the detrusor and urethral sphincter. This may lead to decreased bladder sensation, weak or uncoordinated contraction, dysuria, urinary retention, and ultimately lead to overflow urinary incontinence, confirming previous research results [21, 22]. The predictive model constructed by these factors has good performance and stability, and the internal verification results are satisfactory. It has high clinical application value, and similar results have been reported before.

Previous follow-up studies on urinary incontinence after stroke have confirmed that although the recovery of neurological function in some patients has been alleviated, about 15%-20% of patients still face persistent urinary incontinence [23, 24]. The results of this study also showed that the incidence of persistent urinary incontinence after stroke in this group was 42.86%, which was higher than that of previous studies, which may be related to the small sample size of this study. At the same time, some scholars have confirmed that persistent urinary incontinence is also related to the baseline data of patients [25]. The baseline results of this group of patients showed that female sex, diabetes, and NIHSS scores were the influencing factors of persistent urinary incontinence, which may be related to the following mechanisms: the congenital anatomical structure of female patients is more complex than that of men, and their pregnancy and fertility history lead to urinary incontinence. Even if the neurological function is restored, the patient's urination function is difficult to recover. Diabetes and high NIHSS scores are associated with the degree of damage to the bladder and urinary control nerves, which ultimately leads to persistent urinary incontinence. The synergistic amplification effect of peripheral neuropathy caused by diabetes and central nervous system injury caused by stroke not only weakens the bladder emptying ability, but also destroys the body's autonomous control of urination, and finally forms persistent urinary dysfunction that is difficult to compensate, resulting in urinary incontinence difficult to recover. This complex synergistic injury mechanism causes urinary incontinence in diabetic patients with high NIHSS scores to fail to recover, and the symptoms persist, which is consistent with the conclusions of previous studies [26, 27].

There are some limitations of the study. First, as a retrospective study, there is selection bias and information bias. Secondly, this study wa a single-center study with limited sample size, which may reduce the universality of the research results. In addition, the lack of external data and external validation may have reduced the reliability of the conclusion, which needs further study. In addition, the relatively short follow-up period prevented the dynamic evolution of urinary incontinence in post-stroke patients and its impact on their long-term quality of life. This requires additional follow-up.

In summary, the results of this study confirmed that post-stroke urinary incontinence was associated with baseline patient characteristics, including NIHSS score, female gender, frontal and thalamic lesions, and diabetes. The prediction model of urinary incontinence after stroke established by these factors has good predictive ability, which can provide theoretical basis for clinicians to identify high-risk patients early and provide personalized intervention. In addition, subsequent studies on urinary incontinence after stroke have shown that early interven-

Table 6. Comparison of baseline data between the two groups

Project	Urinary incontinence recovery group (n = 24)	Persistent urinary incontinence group (n = 18)	Statistics	*P*-value
Age (years)	70.14 ± 7.32	67.24 ± 8.51	1.201	0.237
Body mass index (kg/m²)	24.38 ± 2.82	25.23 ± 3.36	-0.978	0.334
Female sex	16 (66.7%)	2 (11.1%)	13.381	< 0.001
Hypertension	17 (70.8%)	13 (72.2%)	0.011	0.917
Diabetes	14 (58.3%)	2 (11.1%)	10.267	0.001
Smoking history	10 (41.7%)	5 (27.8%)	0.883	0.347
Alcohol use history	8 (33.3%)	4 (22.2%)	0.617	0.432
NIHSS Score	13.24 ± 2.52	7.53 ± 2.21	7.823	< 0.001
Hematoma Size (mL)	32.53 ± 10.12	26.81 ± 9.42	1.858	0.071
Accompanied by aphasia	13 (54.2%)	6 (33.3%)	1.925	0.165
Cerebral hemorrhage	15 (62.5%)	10 (55.6%)	0.209	0.648
Number of strokes ≥ 2	7 (29.2%)	3 (16.7%)	0.921	0.337

Table 7. Logistic regression analysis of influencing factors of persistent urinary incontinence after stroke

Influencing factors	β value	Standard error	Wald χ² value	OR value	95% CI	*P* value
NIHSS score	0.284	0.062	20.978	1.328	1.176-1.500	0.031
Female sex	1.815	0.872	10.423	6.703	3.023-2.268	0.021
Diabetes	1.962	0.829	5.602	7.109	1.404-3.770	0.018

NIHSS: National Institutes of Health Stroke Scale.

tion should be targeted at women, patients with high NIHSS scores and diabetes to reduce persistent urinary incontinence, thereby improving the diagnosis and treatment of these patients.

Disclosure of conflict of interest

None.

Address correspondence to: Jing Xu, Department of Neurology, Ma'anshan People's Hospital, Huashan District, Ma'anshan 243000, Anhui, China. Tel: +86-0555-96501; E-mail: wangyiyou20251028@163.com

References

[1] Feigin VL, Brainin M, Norrving B, Martins SO, Pandian J, Lindsay P, F Grupper M and Rautalin I. World stroke organization: global stroke fact sheet 2025. Int J Stroke 2025; 20: 132-144.

[2] Potter TBH, Tannous J and Vahidy FS. A contemporary review of epidemiology, risk factors, etiology, and outcomes of premature stroke. Curr Atheroscler Rep 2022; 24: 939-948.

[3] Helboe KS, Eddelien HS and Kruuse C. Visual symptoms in acute stroke - a systematic review of observational studies. Clin Neurol Neurosurg 2023; 229: 107749.

[4] Perera KS, de Sa Boasquevisque D, Rao-Melacini P, Taylor A, Cheng A, Hankey GJ, Lee S, Fabregas JM, Ameriso SF, Field TS, Arauz A, Coutts SB, Arnold M, Mikulik R, Toni D, Mandzia J, Veltkamp RC, Meseguer E, Haeusler KG and Hart RG; Young ESUS Investigators. Evaluating rates of recurrent ischemic stroke among young adults with embolic stroke of undetermined source: the Young ESUS longitudinal cohort study. JAMA Neurol 2022; 79: 450-458.

[5] Jiang Z, Zhi N, Liu G, Sun X, Chen X, Ma D, Guo M, Wang S and Zhang H. Electroacupuncture for post-stroke urinary incontinence: a systematic review and meta-analysis with trial sequential analysis. Front Neurol 2023; 14: 1282580.

[6] Cruz E, Miller C, Zhang W, Rogers K, Lee HJ, Wells Y, Cloud GC and Lannin NA. Does non-implanted electrical stimulation reduce post-stroke urinary or fecal incontinence? A systematic review with meta-analysis. Int J Stroke 2022; 17: 378-388.

[7] Qiu Z, Li W, Huang Y, Huang W, Shi X and Wu K. Urinary incontinence and health burden of female patients in China: subtypes, symptom severity and related factors. Geriatr Gerontol Int 2022; 22: 219-226.

[8] Scharp D, Harkins SE and Topaz M. Symptom burden: a concept analysis. Nurs Sci Q 2025; 38: 174-184.

[9] Wei D, Meng J, Zhang Y, Chen Y, Li J and Niu X. Identification of potential associated factors for stress urinary incontinence in women: a retrospective study. Ann Transl Med 2022; 10: 965.

[10] Hoh BL, Ko NU, Amin-Hanjani S, Chou SH-Y, Cruz-Flores S, Dangayach NS, Derdeyn CP, Du R, Hänggi D, Hetts SW, Ifejika NL, Johnson R, Keigher KM, Leslie-Mazwi TM, Lucke-Wold B, Rabinstein AA, Robicsek SA, Stapleton CJ, Suarez JI, Tjoumakaris SI and Welch BG. 2023 guideline for the management of patients with aneurysmal subarachnoid hemorrhage: a guideline from the American Heart Association/American Stroke Association. Stroke 2023; 54: e314-e370.

[11] Markus HS and Michel P. Treatment of posterior circulation stroke: acute management and secondary prevention. Int J Stroke 2022; 17: 723-732.

[12] Holroyd S. Urinary incontience after stroke. Br J Community Nurs 2019; 24: 590-594.

[13] Gordon C, Davidson CE, Roffe C, Clegg A, Booth J, Lightbody CE, Harris C, Sohani A and Watkins C. Evaluating methods of detecting and determining the type of urinary incontinence in adults after stroke: a systematic review. Neurourol Urodyn 2024; 43: 364-381.

[14] Tonani LL, Bortolini MAT, Santos RGM, Fukujima MM and Castro RA. Correlation between ischemic stroke topography and female urinary incontinence. Eur J Obstet Gynecol Reprod Biol 2023; 291: 206-211.

[15] van Dam-Nolen DHK, Truijman MTB, van der Kolk AG, Liem MI, Schreuder FHBM, Boersma E, Daemen MJAP, Mess WH, van Oostenbrugge RJ, van der Steen AFW, Bos D, Koudstaal PJ, Nederkoorn PJ, Hendrikse J, van der Lugt A and Kooi ME; PARISK Study Group. Carotid plaque characteristics predict recurrent ischemic stroke and TIA: The PARISK (Plaque At RISK) Study. JACC Cardiovasc Imaging 2022; 15: 1715-1726.

[16] Liu Y, Li W, Zhou H, Zeng H, Jiang J, Wang Q, Liu T, Liu X, Chen P and Zhong X. Association between atherogenic index of plasma and new-onset stroke in a population with cardiovascular-kidney-metabolic syndrome stages 0-3: insights from CHARLS. Cardiovasc Diabetol 2025; 24: 168.

[17] Sullivan SA, Davidson ER, Bretschneider CE, Liberty AL and Geller EJ. Patient characteristics associated with treatment choice for pelvic organ prolapse and urinary incontinence. Int Urogynecol J 2016; 27: 811-816.

[18] Hernandez S, Mill C, Irvine D, Clarke K, Granger CL, Da Silva A and Bower W. Can gait outcomes be predicted early after a stroke? Physiother Theory Pract 2023; 39: 2154-2162.

[19] Duarte E, Marco E, Muniesa JM, Belmonte R, Aguilar JJ and Escalada F. Early detection of non-ambulatory survivors six months after stroke. NeuroRehabilitation 2010; 26: 317-323.

[20] Batmani S, Jalali R, Mohammadi M and Bokaee S. Prevalence and factors related to urinary incontinence in older adults women worldwide: a comprehensive systematic review and meta-analysis of observational studies. BMC Geriatr 2021; 21: 212.

[21] Liu G and Daneshgari F. Diabetic bladder dysfunction. Chin Med J (Engl) 2014; 127: 1357-1364.

[22] Erdogan BR, Liu G, Arioglu-Inan E and Michel MC. Established and emerging treatments for diabetes-associated lower urinary tract dysfunction. Naunyn Schmiedebergs Arch Pharmacol 2022; 395: 887-906.

[23] Shen C, Zhu X, Chen Z, Zhang W, Chen X, Zheng B and Gu D. Nomogram predicting early urinary incontinence after radical prostatectomy. BMC Cancer 2024; 24: 1095.

[24] Sadeghi MA, Hemmati S, Emami Razavi SZ, Vahabizad F, Yekaninejad MS and Azadvari M. Prevalence and features of post-stroke urinary incontinence: a retrospective cohort study. Arch Iran Med 2023; 26: 234-240.

[25] Feigin VL, Barker-Collo S, Parag V, Hackett ML, Kerse N, Barber PA, Theadom A and Krishnamurthi R; Auckland Regional Community Stroke Study Group. Prevalence and predictors of 6-month fatigue in patients with ischemic stroke: a population-based stroke incidence study in Auckland, New Zealand, 2002-2003. Stroke 2012; 43: 2604-2609.

[26] Devore EE, Minassian VA and Grodstein F. Factors associated with persistent urinary incontinence. Am J Obstet Gynecol 2013; 209: 145, e1-e6.

[27] Moris L, Heesakkers J, Nitti V, O'Connell HE, Peyronnet B, Serati M, Omar MI and Harding C. Prevalence, diagnosis, and management of stress urinary incontinence in women: a collaborative review. Eur Urol 2025; 87: 292-301.