**SUMMARY**

**Aim:** To provide a comprehensive review of the current evidence on post-stroke urinary incontinence. **Method:** An electronic database search was performed to identify relevant studies and review articles related to Urinary Incontinence (UI) in the stroke population between the years 1966 and 2012. **Findings:** Urinary incontinence following stroke is a common problem affecting more than one-third of acute stroke patients and persisting in up to a quarter at 1 year. It is well established that this condition is a strong marker of stroke severity and is associated with poorer functional outcomes and increased institutionalisation and mortality rates compared with those who remain continent. Despite evidence linking better outcomes to those patients who regain continence, the results of national audits have demonstrated that the management of UI following stroke is suboptimal, with less than two-thirds of stroke units having a documented plan to promote continence. **Conclusion:** Current evidence supports a thorough assessment to categorise the type and severity of post-stroke urinary incontinence. An individually tailored, structured management strategy to promote continence should be employed. This has been associated with better stroke outcomes and should be the aim of all stroke health professionals.

**Introduction**

Every year over 150,000 people in the UK are affected by stroke, accounting for 11% of all deaths in England and Wales (1). Urinary incontinence (UI) is a common sequela of acute stroke affecting more than a third of stroke patients admitted with up to a quarter of these patients remaining incontinent at 1 year (2–6). Post-stroke UI is a strong predictor of higher rates of mortality, greater institutionalisation and increased disability (3,4,7–13). This condition is potentially treatable and evidence suggests that regaining continence is associated with better stroke outcomes highlighting the necessity for clinicians to address and manage this serious complication of acute stroke (6,8,12).

This article aims to review the current literature on the important aspects of post-stroke UI including: the prevalence, the natural history, the pathophysiology of UI following a stroke, the effects on stroke outcomes, the assessment processes and finally the evidence-based interventions to treat this condition. Relevant studies were identified by performing an electronic database search of Medline, EMBASE, the Cochrane Library, HMIC and CINAHL, using the following MeSH and keywords: Urinary; Incontinence; Stroke. All articles between the years 1966 and 2012 were included. Articles without an available English translation were excluded. The resultant information was supplemented by extensive manual searching of references to identify any further studies. Studies relating to interventions were assessed for methodology and all randomised controlled trials were grouped in terms of the type of intervention performed (Table 2). A formal evaluation of the level of evidence was not performed in developing this narrative review.

**Message for the clinic**

It is important to identify the presence of UI in all patients following an acute stroke. This condition may be treatable and those patients who regain continence have improved stroke outcomes with less disability and lower mortality rates. A thorough assessment to determine the type of UI and functional capabilities of the patient should be undertaken to allow individually tailored treatment strategies to be provided.
Extent of the problem

The International Continence Society has defined UI as ‘the involuntary loss of urine that is a social or hygienic problem’ (14). This definition may be further divided according to the patient’s symptoms. Urinary incontinence following acute stroke is common although there is considerable variation in the reported prevalence rates. Brittain et al. identified rates of UI at hospital admission following stroke ranging from 32% to 79% based on data from nine hospital-based studies published between 1985 and 1997 (2). Kolominsky-Rabas et al. conducted a community-based study over a four-year period, which included almost 700 patients presenting with a new stroke (3). They reported that 35% of previously continent patients were incontinent at 7 days following a stroke. Patel et al. found similar rates in a population-based study in 2001, with 40% of individuals incontinent at 7–10 days post admission (4). Wilson et al. analysed data from the UK National Sentinel Stroke Audits between 1998 and 2004 and identified UI rates of 39–44% at 1 week (5). This variation in published prevalence rates may be because of several factors including the use of different definitions of UI, failures to account for the presence of premorbid incontinence and the measurement of UI at different points in time in addition to differing population samples (i.e. community vs. hospital).

Natural history of urinary incontinence after stroke

Although some resolution of UI occurs with time, a significant number of patients remain incontinent at 1 year (3–7,15). Patel et al. explored the natural history of UI in 235 participants over a 2-year period through personal interviews and postal questionnaires and reported the following prevalence rates: 19% at 3 months, 15% at 1 year and 10% at 2 years (4). More recently, Rotar et al. prospectively evaluated 100 patients presenting with a first ever stroke for the presence of lower urinary tract dysfunction using a questionnaire and ultrasound scan (6). At 72 h, more than half of the population experienced symptoms but at 1 year this had reduced to 9% of stroke survivors. Two further studies have demonstrated rates of persistent UI at 1 year of 24% to 27% (3,7). All of these studies excluded patients with premorbid UI, but definitions and assessment methods of UI varied, which may account for the difference in reported prevalence rates.

Some factors have been identified as predictors of persistent UI in stroke patients. Williams et al. discovered that increasing age, female sex and stroke severity were independent predictors of UI at 12 months and Patel et al. found that patients aged 75 and older were less likely to regain continence at 3 months (7,8). They also reported that patients who had experienced total anterior circulatory infarcts were less likely to regain continence at 3 months and that compared with such patients, patients suffering lacunar infarcts had an odds ratio for regaining continence of 3.65 (95% CI: 1.1–12.2) (8). Haemorrhagic or ischaemic aetiology of stroke did not appear to have a significant effect on patients remaining incontinent (22.5% haemorrhagic; 70.0% ischaemic) or regaining continence (20.5% haemorrhagic; 70.1% ischaemic) at 3 months. Gelber et al. prospectively investigated the bladder function of 51 patients with unilateral hemispheric stroke, 19 of who had UI (16). They identified a significant correlation between large infarcts involving both cortical and subcortical regions and the development of UI and concluded that such infarcts were more likely to result in damage to the neuromicturition pathways directly leading to UI and to result in cognitive and/or language barriers indirectly affecting continence. In addition, the authors reported that no correlation was evident between the location of the stroke lesion and the development of UI. Other studies have reported similar findings suggesting that the size of the stroke lesion is a better predictor of the development of UI rather than the location (8,16–18).

Neural control of micturition

It is important to consider the normal control of micturition before examining the causes of UI following a stroke. The control of micturition is mediated by complex neural mechanisms located in the brain, spinal cord and peripheral ganglia (19). These mechanisms control smooth and striated muscle activity of the urinary bladder, the bladder neck, the urethra and the urethral sphincter to allow bladder filling and voiding to take place in a coordinated manner (Figure 1).

Current evidence indicates that the voiding reflex, mediated by the spinobulbospinal pathway, operates as a switch that is either completely ‘off’ during bladder filling or ‘on’ during voiding (19,20). During bladder filling, low intensity afferent signals pass through the pelvic nerves to the spinal cord, which results in inhibition of parasympathetic innervation of the detrusor muscle of the bladder. This process also stimulates sympathetic outflow in the hypogastric nerve contracting the bladder outlet (base of the bladder and urethra) and pudendal outflow via neurons in Onuf’s nucleus contracting the external urethral sphincter. These spinal reflexes are known collectively as the ‘guarding reflex’ and promote continence. In
addition, a region in the lateral pons known as the ‘pontine storage area’ may contribute by stimulating striated urethral sphincter activity (19–21).

At a critical level of bladder distension, afferent signals, via the pelvic nerves to the spinal cord, intensify switching the spinobulbospinal pathway to maximal activity (19–21). Ascending afferent input from the spinal cord is relayed to the pontine micturition centre (PMC) of the brain via the periaqueductal grey (PAG). Excitation of the PMC activates descending pathways, which leads to inhibition of sympathetic and pudendal outflow to the urethral outlet resulting in urethral relaxation and stimulation of parasympathetic outflow to the bladder resulting in detrusor contraction.

The voiding pathway is under strict voluntary control by higher brain centres (19–21). Functional brain magnetic resonance imaging strongly suggests various higher brain centres play an important role in the voiding decision: the prefrontal cortex, in particular the right inferior frontal gyrus, the anterior cingulate cortex, the thalamus, the caudal hypothalamus and the insula (19,21). The PAG has a pivotal role in relaying ascending bladder signals to the higher brain centres and receiving signals from these centres to control primary input into the PMC, allowing voiding to take place only when socially desired. This is achieved by suppressing the excitatory signal to the PMC inhibiting the voiding reflex (19,21).

### Causes and types of urinary incontinence after stroke

Post-stroke UI may develop because of various different causes although current data is inconclusive as to which of these causes is associated with worse stroke outcomes (Figure 2).

### Direct damage to the neuromicturition pathways caused by the stroke lesion

Disruption of these pathways leads to uninhibited bladder contraction, termed detrusor overactivity and subsequent urge incontinence, the most commonly reported cause of post-stroke UI (16,22,23).
Typical symptoms include the involuntary leakage of urine accompanied by urgency and urodynamic assessment often reveals uninhibited detrusor contraction. Studies using urodynamic evaluation highlight wide variations in the reported prevalence rates of this abnormality in stroke patients, ranging from 37% to 90% (16,24–27). Whilst some studies have been unable to detect a significant association between the presence of detrusor overactivity and the site of the stroke lesion (25,26), Petteisen et al. demonstrated that new lesions in the frontal lobes were associated with urge UI and Sakakibara et al. noted lesions in the frontal lobe as well as the basal ganglia to be associated with detrusor hyperreflexia (24,28).

**Detrusor hyporeflexia with overflow incontinence**

Detrusor hyporeflexia following an acute stroke has also been reported in a number of studies with prevalence rates ranging from 21% to 35% (16,18,23,26). It has been suggested that this type of incontinence may occur in acute stroke because of initial loss of bladder tone; however Gelber et al. noted that non-stroke factors such as the use of anticholinergic medications or diabetic polyneuropathy were present in this group and may have accounted for this finding (16). Typical symptoms of detrusor hyporeflexia include dribbling and/or continuous leakage of urine associated with incomplete bladder emptying and urinary retention (22).

**Impaired awareness urinary incontinence**

Pettersen et al. performed several hospital-based prospective studies looking at impaired awareness UI post-stroke (9,28,29). This has been defined as ‘UI with reduced ability to be aware of bladder signals before leakage, to take notice of eventual leakage, or both’ (29). Symptoms ranged from slight unawareness to anosognosia. In their cohort of 65 patients, 38 were found to have impaired awareness and they reported that this type of UI was an independent risk factor for poor outcome, both at 3 months and at 1 year, (28,29). The authors demonstrated that, compared with patients with urge UI, these patients had more total or partial anterior circulation strokes, less new frontal lobe involvement, but more new parietal lobe and subcortical damage, and poorer cognitive and functional independence (28). The authors suggested that in contrast to the role played by frontal lobe structures in the conscious recognition of afferent bladder signals and the volitional inhibition
of the micturition reflex, correct identification and validation of the signals in a given social situation are likely to depend also on parietal and temporal functions. The authors commented however that patients with severe aphasia were excluded from their investigations, limiting the significance of their findings (28).

**Indirect stroke-related causes with normal bladder function (Functional incontinence)**

Communicative, cognitive and mobility difficulties may indirectly impact on a patient's ability to maintain continence despite a normal bladder function (2,4,16). This is usually referred to as 'functional incontinence'. Gelber et al. reported significant and independent associations between the presence of aphasia and/or cognitive impairment and the development of UI (16). In a larger study by Patel et al. the following factors were identified on multivariate analysis to be significantly associated with initial UI: dysphagia, visual field defects, motor weakness and age $>75$ although no association was found with presence of aphasia (4).

**Stress incontinence**

Stroke does not directly cause stress incontinence, however it may aggravate a pre-existing problem. This type of UI usually results from weakness of the pelvic floor muscles, which may be further exacerbated, by the reduced pelvic muscle tone and motor weakness caused by a stroke. In addition, excessive coughing caused by aspiration pneumonia following stroke may contribute to this (22).

**Transient causes of urinary incontinence**

Transient and potentially reversible causes of UI that are not directly associated with stroke should be considered such as: faecal impaction, delirium, medications, urinary tract infections and atrophic vaginitis.

**Effects on stroke outcomes**

The development of UI following a stroke has been strongly associated both with increased mortality rates and poor functional outcomes (3,4,6,8,10,11). This relationship has been reported to be independent of other prognostic factors. Patel et al. investigated the impact of post-stroke UI on post-stroke disability and institutionalisation rates. On multiple logistic regression analysis, incorporating factors such as age, gender and stroke type, they found that persistent UI was independently associated with worse outcome, with an institutionalisation rate of 27% compared with 9% in the continent group (8). Kolominsky-Rabas et al. reported even higher institutionalisation rates of 45% at 1 year - a fourfold higher risk compared with those who regained continence (3). Taub et al. reported that post-stroke UI at 3 months was found to be the single best predictor of moderate to severe disability in stroke patients under the age of 75 (12).

Other studies have demonstrated that post-stroke UI is independently associated with higher mortality rates (4,6). Through multiple logistic regression analyses Rotar et al. demonstrated significantly higher mortality rates in those patients who remained incontinent at time intervals of 1 week, 6 and 12 months (6). They also reported that those who regain continence in the first week following stroke had a similar prognosis to those with normal bladder control (6). Similarly, Barer et al. found that stroke outcomes were better in those patients who regained continence or remain continent (13).

There are likely to be several reasons why post-stroke UI is associated with poor outcome. Firstly, UI adversely affects the ability of patients to participate in stroke rehabilitation therapy (30,31). Both physical and psychological factors may impact on poor response to rehabilitation. This condition can have a devastating psychological impact on both the patient and their carer. Urinary symptoms may interfere with activities of daily living, sleep patterns, social activities and personal relationships resulting in feelings of fear, embarrassment and guilt. Brittain et al. demonstrated in a multivariate analysis that depression after stroke was 2.4 (95% CI: 1.89–2.93) times more likely in those patients with urinary dysfunction compared with those without (32). Low morale and self-esteem may lead to poor concentration, apathy and a reduced desire to participate in stroke rehabilitation. A community based-postal survey examining the impact of urinary symptoms on the lives of stroke survivors reported that after controlling for age and sex using a multivariate regression logistic model, stroke survivors was more likely to report that urinary symptoms had a negative impact on their lives compared with the non-stroke population (15). For example, 23% of stroke patients reported that their symptoms interfered with sleep compared with 9% in the non-stroke group. Secondly, UI is a marker of stroke severity and has been related to coma states, which may explain why this condition is associated with poor stroke outcome (33). Finally, UI has been independently associated with an increased risk of falls, urinary tract infections, skin break down and an increased length of hospitalisation (34).

Premorbid UI has also been associated with poor stroke outcomes (4,35). Jawad et al. examined this relationship and reported that almost 80% of patients who died prior to their 6 month functional assessment were premorbidly incontinent (35).
et al. reported that of the 16 patients excluded from their study on the basis of preexisting urinary incontinence, 3 died within the first week, 7 died within 3 months and 4 died within 2 years. The studies however, did not demonstrate that premorbid incontinence was an independent risk factor for worse stroke outcomes, and may simply be a marker of premorbid frailty (4).

**Assessment of urinary incontinence after stroke**

Given the multiple aetologies of, and factors associated with UI following stroke, a thorough assessment is required to delineate the type and severity of incontinence, so that treatment can be tailored to meet the individual's needs. There is a paucity of studies evaluating assessment processes used by healthcare professionals in post-stroke UI but current assessment methods are shown in Table 1.

The National Clinical Guideline for Stroke produced by the Royal College of Physicians, London, UK recommends that ‘all wards and stroke units have established assessment and management protocols for UI and that patients with continued loss of bladder control 2 weeks after the diagnosis should be re-assessed to identify the cause of incontinence’ (1). If the cause of UI remains unclear after a thorough

| Assessment | Rationale |
|------------|-----------|
| Basic nursing assessment within 24 h of admission | To identify those patients who are incontinent of urine |
| History taking | |
| Onset and duration of symptoms? Urgency? Dribbling? | To determine the type of urinary incontinence |
| Are symptoms related to a specific activity? e.g. coughing, sneezing | To plan appropriate management strategies |
| Pre-existing incontinence? | To determine problems caused by UI and/or contributing to it |
| Associated bowel symptoms? | |
| Medications (diuretics, anticholinergics, oestrogens, sedatives, and antidepressants) | |
| Fluid intake? | |
| Medical history – diabetes, recurrent urinary tract infections and dementia | |
| Cognitive abilities? | |
| Functional capacity: dexterity, mobility and aids | |
| Effect on quality of life? | |
| Clinical assessment | |
| Clinical examination: neurological and abdominal examination, rectal and pelvic examinations | To assess for a palpable bladder suggestive of urinary retention, constipation and/or any prolapse, atrophy or signs of infection |
| Urinary frequency and volume charting for 5–7 days | To assess current pattern of voiding, and bladder capacity |
| Fluid intake charting | To determine if symptoms are worse at particular times of the day – to plan schedule for prompted voiding |
| Bowel chart | |
| Functional capacity of toilet skills (22) | |
| Initial Investigations | To assess ability to get to a toilet or request for help |
| Urinalysis | To assess ability to manage clothing and maintain appropriate posture to allow micturition |
| Post void residual volumes using a bladder scanner | |
| Transient causes of UI Pneumonic: DIAPERS (57) | Evidence of incomplete emptying and urinary retention |
| Delirium | |
| Infection | Consider causes such as chronic chest infections leading to continual strain on the urethral sphincter caused by coughing or polyuria in diabetes for example |
| Atrophic urethritis/vaginitis | |
| Pharmaceuticals | |
| Psychiatric | |
| Excess urine output | |
| Restricted mobility | |
| Stool impaction | |
| Consideration of non-neurological causes of UI | |

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**Table 2** Randomised controlled trials of interventions to treat post-stroke urinary incontinence

| Study                  | Subjects and study design                                                                                              | Results                                                                                                                                                                                                 | Conclusions                                                                                       |
|-----------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| **Behavioural Interventions** |                                                                                                                     |                                                                                                                                                                                                         |                                                                                                   |
| Lewis et al. (36)     | Comparison of sensory-motor biofeedback plus timed voiding in 11 patients vs. timed voiding alone in 12 patients. All subjects suffered from urge urinary incontinence. | Fewer incontinence episodes in the intervention group (WMD 2.20, 95% CI 0.12–4.28).                                                                                                                    | Larger trials are needed to evaluate the effectiveness of this intervention.                      |
| Gelber and Swords, (37) | Comparison of timed voiding in 8 patients vs. voiding on request (interpreted as usual care) in 10 patients.          | Data obtained were too few for any useful analysis.                                                                                                                                                     | No conclusions could be drawn as insufficient data was obtained.                                  |
| Tibaek et al. (38)    | Comparison of the impact of an intensive pelvic floor-training programme in 26 women with mixed stress/urge UI vs. usual care (general rehabilitation). | No significant difference found on either the mean number of incontinence episodes (WMD -1.00, 95% CI −2.74–0.74) or on impact on quality of life as measured by the mean score on the SF36 Health Survey Questionnaire. | Insufficient evidence to advocate the use of pelvic floor training in mixed stress/urge UI post-stroke. |
| **Specialised Professional Input** |                                                                                                                     |                                                                                                                                                                                                         |                                                                                                   |
| Wikander et al. (39)  | Hospital-based prospective comparison of patients randomly allocated to a ward using conventional methods of rehabilitation (n = 13) or to a ward practicing rehabilitation based on assessment using the Functional Independence Measure (FIM) (n = 21). All patients were assessed on admission and on discharge. | 20 patients in the intervention group regained continence before discharge compared with 3 in the control group (p < 0.01). Greater improvement in functional well-being in the intervention group compared with the control group p < 0.01. | Rehabilitation based on use of FIM may reduce rates of UI and enhance functional well-being better than conventional methods of rehabilitation (although small sample size and lack of blinding of outcome measures). |
| Brittain et al. (40)  | Community based prospective comparison of care by a Continence Nurse Practitioner of 152 patients including assessment and treatment vs. usual care provided by the General Practitioner of 80 patients. | Rate of incontinence lower in the intervention group (40/73 vs. 31/48 RR 0.85 CI 0.63–1.14) Reduced number of urinary symptoms in the intervention group at three months (p < 0.01) and at six months (p = 0.06) | Specialised input and individualised care plans may reduce the number of urinary symptoms (although confidence intervals were wide, not fully reported and wide definition of UI used). |
| **Complementary Therapy** |                                                                                                                     |                                                                                                                                                                                                         |                                                                                                   |
| Chu et al. (41)       | Comparison of scalp acupuncture in 30 patients vs. usual care (which included receiving acupuncture combined with nursing care) in 30 patients. | A reduction in urinary frequency and incontinence in 90.3% in the intervention group (p = 0.05–0.001). No results reported for the control group. | Insufficient results reported to draw conclusions.                                                |
| Zhou et al. (42)      | Prospective comparison of the use of eye and scalp acupuncture in 40 patients vs. no acupuncture in 40 patients.         | Lower rates of UI reported in the intervention group (18/40 vs. 32/40).                                                                                                                               | Acupuncture may be an effective intervention in post-stroke UI, however quality of study is questionable as minimal methodological detail is reported. |
| Zhang et al. (43)     | Comparison of acupuncture in 36 patients vs. usual care using mannite and other unspecified medicines in 28 patients. | Lower rates of UI reported in the intervention group (6/36 vs. 26/28).                                                                                                                                | Acupuncture may be an effective intervention in post-stroke UI, however the quality of study is questionable as minimal methodological detail is reported. |
| Liu et al. (44)       | Comparison of ginger-salt partitioned moxibustion plus routine acupuncture in 39 patients vs. routine acupuncture in 36 patients. | Significant difference reported in the intervention group on mean voiding frequency (WMD −5.57, 95% CI −7.00 to −4.14) and on mean nighttime voiding frequency (WMD -3.18, 95% CI −3.95 to −2.41). | This may be an effective intervention, however the quality of study is questionable as minimal methodological detail is reported. |
| **Pharmacotherapy**    |                                                                                                                     |                                                                                                                                                                                                         |                                                                                                   |
| Judge et al. (45)     | Cross over trial comparing the use of oestrogen (quienestraldol 0.25 mg 4 times a day) against placebo in 13 female patients admitted to long-stay geriatric hospitals. | Results reported separately for patients with mild or severe incontinence. Combined results were not statistically significant (paired samples means −3.88 95% CI −8.42–0.66). | Insufficient evidence to support use of this intervention in post-stroke UI.                     |
assessment has been undertaken as detailed in Table 1, then urodynamic studies may be warranted.

### Interventions

Evidence-based interventions in post-stroke UI are limited, but to date, 12 randomised controlled trials with a total of 724 participants have been completed that investigated treatment strategies of UI after stroke (36–46). Unfortunately, all of these trials had a relatively small sample size with wide confidence intervals and nine did not specify if patients with pre-morbid incontinence had been excluded. Table 2 summarises the key findings from these studies and a meta-analysis concluded that there was insufficient evidence to guide practice, but that a structured assessment and specialist continence nursing is likely to reduce rates of post-stroke UI (47). Other trials also support adopting a structured approach to regain continence including work by Herr-Wilbert et al. which demonstrated a 67% success rate in regaining continence within 30 days of stroke, using individually tailored interventions after a nurse-led assessment process (48–51).

The type of UI and the patient’s functional abilities will determine the treatment strategy employed and Table 3 outlines current recommended interventions for different types of UI following stroke. As there is limited stroke-specific research evaluating these interventions, general principles used in the universal treatment of UI may be adopted (48,52). Current interventions include bladder retraining, timed or prompted voiding, intermittent catheterisation and the use of anticholinergic medications. In addition to these measures, environmental and lifestyle interventions need to be considered such as easy access to the toilet, use of hand-held urinals (men and women), access to a call bell, easy to remove clothing, reducing caffeine intake and changes to medications exacerbating incontinence (22). If UI persists despite these measures, containment devices may be required. Containment appliances for men include a penile sheath or absorbent pads and for women, absorbent pads and pants are used (22).

### Implications for future research

Current guidelines recommend that stroke units have a protocol for continence promotion (1,53,54) but the results of the 2010 UK National Sentinel Stroke Audit revealed that only 63% of patients had a documented plan to promote urinary continence (55). Furthermore, 20% of patients were catheterised in the first week and in 10% of these patients the reason for catheterisation was not documented. Clearly, there is a need for significant improvements to be made at a national level in the promotion of continence following a stroke to ensure adherence to best practice guidance. More robust trials are required to evaluate different treatment strategies in patients.
with various types of post-stroke UI to allow evidence-based treatment protocols to be developed specifically for the stroke population.

Currently, a 4-year research programme, ICONS: Identifying Continence Options after Stroke is in progress evaluating the clinical and cost-effectiveness of a systematic voiding programme for the management of UI after stroke (56). Twelve NHS stroke sites are being randomised to receive either the systematic voiding programme, with or without supported implementation measures, or usual care. The voiding programme includes the following interventions: bladder training, timed voiding, prompted voiding, habit training and pelvic floor muscle training. The results of this study will hopefully provide us with more vigorous evidence to guide management strategies in post-stroke UI.

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