REVIEW

A review of post-stroke urinary incontinence

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Introduction: *Cerebrovascular accidents, or strokes, are a common cause of morbidity and mortality in the United States. Urinary incontinence is a prevalent morbidity experienced by post-stroke patients that is associated with long term disability and institutionalization effects on these patients.*

Materials and methods: *An extensive literature review was conducted using multiple academic search engines using the keywords: "stroke," "CVA," "urinary incontinence," "urodynamics," "pharmacologic treatments," and "conservative treatments." Articles were reviewed and summarized to explain incidence, assessment, and treatments of urinary incontinence in post-stroke individuals.*

Results: *Twenty-eight percent to seventy-nine percent of stroke survivors experience urinary incontinence with detrusor overactivity being the most common type of incontinence assessed by urodynamic studies. There continues to be insufficient data studying the effects and benefits of non-pharmacologic and pharmacologic treatments in post-stroke patients. Similarly, urinary incontinence remains an indicator of increased morbidity, disability, and institutionalization rates in the post-stroke patient.*

Conclusions: *Stroke is a debilitating disease which causes urinary incontinence in many patients. As a result, patients have increased rates of hospitalization and disability compared to post-stroke patients without urinary incontinence. The history and physical exam are key in diagnosing the type of urinary incontinence with urodynamic studies being an adjunctive study. Non-pharmacologic treatment, such as behavioral therapy, and pharmacologic agents including antimuscarinics and beta adrenergic medications, are not well studied in the post-stroke patient. Urinary incontinence in stroke patients needs to be further studied to help decrease morbidity and mortality rates within this population.*

Key Words: cerebrovascular accident, urinary incontinence

Introduction

In the United States, more than 795,000 people experience a cerebrovascular accident (stroke) every year; 610,000 of these individuals have had no prior cerebrovascular accidents.[1] Stroke is the fifth leading cause of death in the United States and is the leading cause of serious long term disability. This article will review the prevalence of post-stroke incontinence (PSI), lower urinary tract symptoms after stroke, risk factors for PSI, medical and quality-of-life impact of PSI, evaluation of PSI, the role of urodynamics in PSI, management of PSI, and the natural history of PSI.

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Prevalence of PSI

In the 1980's, numerous scientists looked at the development of urinary incontinence in patients who had suffered a cerebrovascular accident. These studies determined the prevalence of urinary incontinence in these patients to be between 28%-79%, Table 1.[2-4] The patients who were incontinent had various other comorbidities in addition to experiencing a cerebrovascular accident: depression, impaired cognition, age, dysphagia, visual field defects, hemiparesis, and motor weakness.[5-7]

In one of the largest longitudinal studies of stroke patients, Divani et al studied non-institutionalized patients over the age of 50 years old that experienced their first time stroke between the years of 1998 and 2006.[9] The authors aimed to determine morbidities resulting from stroke in this patient cohort. Divani et al found elderly individuals who had suffered a

TABLE 1. **Patient prevalence of stroke and post-stroke incontinence**

Clinical findings	Percentage
Prevalence of CVA in the United States	2.68
Prevalence of post-CVA incontinence	28-79

CVA = cerebrovascular accidents

stroke were more likely to develop motor impairment, urinary incontinence, sleep disturbances, fall risk, and memory deficits compared to controls.[9] The prevalence of urinary incontinence in this study was 28% with long term urinary incontinence occurring in 19% of patients.[9]

Lower urinary tract symptoms after stroke

The most common urinary symptom experienced after a stroke is urinary retention due to detrusor areflexia caused by cerebral shock.[10-12] After this initial shock period, patients post-stroke can develop various types of urinary incontinence. The majority of patients develop overactive bladder symptoms due to direct damage to the neuromicturition pathway by their stroke; however, Pizzi et al discovered the location of a stroke does not impact urinary incontinence, but it is rather the size effect of a stroke that matters.[13] Post-stroke patients can also have symptoms of overflow incontinence as a result of underactive bladder. Strokes often cause poor cognitive and functional independence, leading to impaired awareness of urinary signals; this most often occurs in anterior circulation strokes or strokes with frontal lobe, parietal lobe, or subcortical damage.[14]

Stroke patients can also have normal bladder function but develop functional incontinence. Functional incontinence is often related to communicative, cognitive, and mobility difficulties that result from the patient's stroke. Risk factors that lead to functional incontinence are dysphagia, visual field defects, motor weakness, and age greater than 75 years old.[7,15] In addition, patients with a pre-existing urinary incontinence after a stroke can have worsened urinary symptoms. A stroke can weaken one's pelvic floor muscles and aggravate an existing stress incontinence problem.[11] In assessing post-stroke urinary incontinence, it is important to rule out transient causes of urinary incontinence as described in the DIAPPERS mnemonic: Delirium, Infection, Atrophic urethritis/vaginitis, Pharmaceuticals, Psychologic disorders, Excessive urine output, Restricted mobility, and Stool impaction.[16]

Risk factors for PSI

Williams et al recorded urinary symptoms and the natural history of urinary incontinence (of at least 1 year duration) in patients after a first-ever stroke in a population-based study.[15] Using a standard urinary symptoms questionnaire, the investigators found individuals with no prior problematic history of urinary symptoms were less likely to develop any type of urinary incontinence after stroke compared to those who had a history of prior urinary symptoms. In addition, the individuals with no history of prior urinary symptoms who developed any type of urinary incontinence after their stroke were more likely to have resolution of their urinary incontinence by the end of the study (72%) compared to those who had a history of prior urinary symptoms (14.7%).[15]

Medical and quality-of-life impact of PSI

The presence of urinary incontinence after a cerebrovascular accident significantly impacts the development of multiple comorbidities in patients. Urinary incontinence affects quality of life, social interactions, physical and emotional discomfort, and functional outcome in individuals.[3,17] Stroke patients with urinary incontinence are also more likely to have greater skin breakdown, higher institutionalization rates, and at 1 month, 6 months, and 12 months have higher mortality rates.[3,17]

Post-stroke dementia and urinary incontinence

The risk of developing dementia after a stroke is four to twelve times greater.[18] Pohjasvaara et al studied developing dementia in patients who had suffered an ischemic stroke.[19] In this study, 31.8% of patients were diagnosed with dementia.[19] In addition, those who developed dementia were more likely to experience neurologic side effects compared to those who had no dementia: 20.6% versus 3.5% had dysphagia, 43.9% versus 25.7% experienced gait impairment, and 14.0% versus 3.5% had urinary incontinence.[19] Similarly, Kamouchi et al also assessed urinary incontinence in post-stroke patients.[20] In this study, 69% of elderly patients who experienced a stroke developed urinary incontinence.[20] Kamouchi et al determined from their study that incontinence was more likely to occur in patients who were older than 75 years old and in those who were not able to complete activities of daily living (ADL).[20] Dementia was discovered to be a common complicating factor in patients who were 75 years and older and in patients who had poor ADLs.[20]

For patients who develop dementia after their stroke, they are limited in planning out future life goals and events. As a result, these patients with post-stroke dementia are not able to achieve life satisfaction.[21] In a study performed by Haacke et al, health-related quality-of-life scores (HRQoLs), assessing mobility, self-care, daily activities, pain, and anxiety/depression, were measured in post-stroke patients after 4 years.[22] Haacke et al determined that HRQoLs declined with decreasing mini-mental status examination scores.[22]

Evaluation of PSI

In the evaluation of post-stroke patients experiencing urinary symptoms the most important aspect of a urinary incontinence work up is a patient's history and physical exam. Questions asked should include: a prior history of incontinence, types of urinary symptoms post-stroke, use of any urine containment methods (diapers, pads, indwelling foley), the time period since their stroke, if urinary symptoms have been progressive since stroke, and any information from previous professional evaluations of urinary incontinence.

Physician should perform thorough genitourinary and vaginal exams. Physicians should also have their patients chart daily urine output and fluid intake using a standard 3-day void diary. In addition, physicians should assess their patient's functional capacity, as functional capacity may have been affected by the stroke. Functional capacity is determined by ADLs and instrumental activities of daily living (IADLs). ADLs include basic daily activities: eating, bathing, dressing, toileting, walking, and transferring. IADLs are more complex determinants of independence: managing finances and medications, handling transportation, shopping, preparing meals, using the telephone, and performing housework and basic home maintenance. Functional capacity is often assessed by standard evaluations like the Barthel index of activities of daily living, the Frenchay activities index, and the modified Rankin scale.[5] A urinalysis, post-void residual (PVR) measurement should be obtained and urodynamics should be considered after completion of a thorough history and physical exam.

The American Urological Association in association with the Society of Urodynamics Female Pelvic Medicine and Reconstructive Urology has recently published guidelines for "Adult Urodynamics" and subsections address the use of both PVR measurements as well as formal urodynamics assessment for the management of neurogenic bladder dysfunction.[23] The guidelines single out cerebrovascular accident as a neurologic condition in which "the development of bladder dysfunction can be profound, but the additional presence of mobility disturbances often clouds the issue of those symptoms that are due to neurogenic bladder versus functional disturbances." As a result, PVR measurements are recommended as part of the initial assessment and follow up of patient with post-stroke voiding dysfunction. The recommendations for formal urodynamics testing are less clear in patients with post-stroke incontinence. However, there is a statement to consider urodynamics testing in post-stroke patients who 1) do not respond to initial medical therapy or 2) have problems with bladder emptying.

The role of urodynamics in PSI

There are many studies that have evaluated the use of urodynamics in post-stroke patients. In a study conducted by Linsenmeyer et al, the most common urodynamic finding occurring after a cerebrovascular accident were uninhibited detrusor contractions with efficient bladder emptying.[24] However, 25% of women and 20% of men in this study did not display detrusor overactivity; these specific patients instead had either no bladder contractions (6% of men and 19% of women) or had normal bladder function (12% of men and 6% of women).[24] In addition, even in those patients who had uninhibited detrusor contractions, 35% of men had obstructive symptoms while 13% of women had inefficient bladder emptying.[24]

Pizzi et al performed urodynamic studies during the post-acute rehabilitation phase in patients who experienced an ischemic stroke. Urodynamic studies were conducted at 1 week and at 30 days after the cerebrovascular accident. Seventy-nine percent of the post-stroke study group exhibited urinary incontinence at 1 week; after 30 days, 12 patients of this incontinent group regained continence (24%).[13] Pizzi et al also discovered no correlation of patient urodynamic findings with the location of a patient's stroke, possibly due to bilateral innervation of the striated urethra sphincter.[13] Similar to previous studies, Pizzi et al found the size of a patient's ischemic stroke correlated more significantly with urinary incontinence, most likely due to a greater functional impairment resulting from the volume of central nervous system pathology.[13]

It is important for physicians to consider performing urodynamics in post-stroke patients if a cause for their urinary symptoms cannot be determined.[25] Urodynamics can aid in diagnosing the type of urinary incontinence in a post-stroke patients and guide medical or surgical management.[25] In addition to performing urodynamic studies, physicians must have a low threshold in evaluating post-stroke patients for visual field defects, poor mobility, and impaired

cognition as these are additional risk factors associated with the development of urinary incontinence.[10,12,26-29]

Management of PSI

Management of post-stroke overactive bladder symptoms can be approached using various treatment methods. Non-invasive treatment options include scheduled voiding every 2 to 3 hours, fluid restriction, and behavioral therapy such as pelvic floor muscle training.[16] Along with non-invasive treatment options, physicians should use pharmacological agents as adjunctive therapy to conservative treatment. The most commonly used pharmacologic agents used to treat post-stroke overactive bladder symptoms are antimuscarinic drugs which target the M3 receptors of the detrusor muscle.[30]

However, physicians must be careful in prescribing antimuscarinic medications to post-stroke patients as these medications can worsen cognition in this at-risk patient population. The M1 and M2 receptors, which are found within the brain, are important in mediating cognitive function and may be affected by antimuscarinic agents, especially if using non-selective muscarinic receptor antagonists.[31] Antimuscarinic drugs that are more likely to impact a patient's cognition are lipophilic tertiary amines. In addition, cognitive symptoms can be exacerbated in patients that lack a P-gp transporter on the blood-brain barrier.[30] Oxybutynin is the antimuscarinic drug with the highest risk of cognitive side effects while trospium chloride has the lowest cognitive side effects.[32] In a randomized control trial by Dubeau et al, the effect of fesoterodine was analyzed in older, medically complex elderly patients. Dubeau et al concluded that flexible doses of fesoterodine significantly improved urge urinary incontinence episodes and was well tolerated versus placebo in these elderly patients.[33] However, this study did not specifically look at PSI. Unfortunately, there have not been many studies analyzing the effects of antimuscarnic agents specifically in post-stroke patients. Other pharmacologic agents that may be used in treatment of post-stroke overactive bladder symptoms are β3 receptors agonists. However, there have been no published studies on the use of these agents in PSI despite improved storage function noted in pre-clinical animal models of experimentally induced stroke.[34]

When medical management is insufficient in managing post-stroke overactive bladder symptoms, minimally invasive surgical therapies are the next step. One treatment is the neuromodulation of the S3 nerve via the percutaneous tibial or sacral nerve. Peters et al studied patients with neurogenic bladder dysfunction, including stroke patients, treated with neuromodulation and found that neuromodulation improved neurogenic bladder dysfunction compared to those without coexisting neurologic conditions, but the study group was extremely small.[35]

Another minimally invasive surgical therapy is the use of botulinum toxin A. Kuo et al looked at patients with chronic cerebrovascular accident and spinal cord patients who were refractory to anticholingeric medications and analyzed their response to botulinum A toxin. The botulinum A toxin only increased bladder capacity and improved incontinence in 50% of stroke patients and these improvements relapsed within 6 months.[36] Last resort treatment for detrusor overactivity is highly invasive surgical treatments: bladder autoaugmentation, enterocystoplasty, and urinary diversion.

Although overactive bladder symptoms are the most common type of urinary symptoms in stroke patients, these patients can also suffer from other types of urinary incontinence and should be treated appropriately.[13,26] Patients with underactive bladder should be prescribed clean intermittent catheterization or an indwelling foley.[16] If a patient has normal bladder function, a physician should perform an assessment of communicative, cognitive, and mobility difficulties as these can cause urinary incontinence in stroke patients.[16] Transient causes of urinary incontinence, easily described using the mnemonic "DIAPPERS", should be treated appropriately.[16]

Overall, an ideal management strategy for urinary incontinence in stroke patients is not well described. Studies have shown early intervention and management of urinary incontinence following an acute stroke significantly improved resolution rates of urinary incontinence versus those who did not receive any type of treatment.[24] There has been limited research conducted on hospitals protocols managing urinary incontinence. There are also a lack of evidence based studies analyzing conservative and/or medical interventions for post-stroke urinary incontinence, in addition to other post-stroke urinary complaints of retention, frequency, and bladder pain. As a result, the majority of treatments used to treat post-stroke urinary incontinence are based on the experience of the health care professional.

The Cochrane Collaboration analyzed 12 trials in a review "Treatment of urinary incontinence after stroke in adults." In this review of 724 participants, multiple types of interventions were studied including physical (catheters, pads, pessaries), behavioral (scheduled voiding, bladder training, pelvic floor muscle training), and complementary (homeopathy, acupuncture)

therapies. In addition, medications (anticholinergics, adrenergics, hormonal treatment) and professional input interventions were analyzed.[37] The review concluded the trials were small and in some trials, data was incomplete. Based on this fact, Thomas et al stated there was little evidence from these stroke specific studies to develop guidelines to manage urinary incontinence in stroke patients.[37] The review found no effect on improved incontinence in patients with professional input interventions versus patients without professional input care. However, there was evidence from the studies that suggested specialized professional input used to assess and manage PSI problems may improve incontinence outcomes, especially in the acute phase of rehabilitation.[37] Specialized professional input also improved patient quality-of-life, patient satisfaction, and patient cost/service use versus patients who did not receive any professional input care.

The natural history of PSI

A study done by Patel et al looked at the natural history of urinary incontinence after a stroke. Survival rates, disability indexes (measured by Barthel index, Frenchay activities index, and Rankin scale scores), and institutionalization rates were measured in patients at 3 months, 1 year, and 2 years. Of the 235 patients, 95 patients (40%) had urinary incontinence and 140 patients (60%) were continent at 7 to 10 days post-stroke.[5] After 3 months, 19% of surviving post-stroke patients were incontinent.[5] Fifteen percent of surviving post-stroke patients remained incontinent at 1 year while 10% remained incontinent at 2 years.[5] In addition, Patel et al also concluded that post-stroke patients who continued to experience urinary incontinence were also more likely to be severely or moderately disabled and had greater institutionalized rates at 2 years compared to continent post-stroke patients.[5]

In a different study, Patel et al also measured factors and outcomes in recovering post-stroke urinary incontinent patients. Patients who were age 75 years and older at the time of their stroke were independently associated with failure to regain urinary continence at 3 months.[7] This finding can be explained by physiologic changes in the bladder as an individual ages; older patients have decreased bladder capacity and higher prevalence of medical comorbidities predisposing to urinary incontinence.[7] In addition, those patients with a Barthel index of 15-18, indicating a lower level of disability, were more likely to regain urinary continence.[7] After 1 week post-stroke, 324 patients (39%) remained incontinent. Of this subgroup at 3 months, 32.4% were deceased, 3.7% were lost to follow up, 24.7% remained incontinent, and 39.2% regained continence.[7]

The impact of urinary incontinence after stroke was also studied by Koloinsky-Rabas et al. The authors looked at 752 patients who experienced their first time stroke. These participants were assessed at 7 days (the acute phase) and were followed up for 12 months after their stroke. At 12 months, the fatality rate in patients who experienced incontinence during the acute phase was 49% versus the 7% fatality rate of continent individuals in the acute phase post-stroke.[38] In addition, at 12 months, 32% of the study participants remained incontinent; of these individuals, 22% of them used an indwelling catheter.[38] Lastly, at 12 months, 45% of patients who were incontinent post-stroke were institutionalized versus the 5% of patients who were continent.[38]

Conclusions

In conclusion, stroke causes multiple comorbidities including urinary incontinence. The most common type of urinary symptoms in post-stroke patients is overactive bladder and the most common urodynamic finding is detrusor overactivity; however, additional stroke comorbidities also may affect patient incontinence including visual field defects, poor mobility, and impaired cognition. Because there are multiple factors that contribute to the development of urinary incontinence in stroke patients, it is important to obtain an accurate history, physical exam, and urodynamics. Depending on the type of urinary incontinence diagnosed in stroke patients, there are multiple treatments. Early treatment has been shown to improve urinary incontinence in these patients. Yet, there is little evidence or specific guidelines regarding appropriate management of post-stroke urinary incontinence. Unfortunately, guidelines are sorely needed as studies show higher rates of institutionalization, psychological impacts, and mortality rates in incontinent stroke patients. Therefore, a critical objective is the development of evidence-based guidelines for the management of urinary incontinence after stroke. □

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