URINARY INCONTINENCE

Background and Epidemiology

The epidemiology of incontinence in the geriatric population has been closely examined. Urinary incontinence is a very common disorder among older adults; it is estimated that between 15% and 35% of community-dwelling adults in the United States aged 60 or over suffer from urinary incontinence. [1] The overall prevalence increases with age in both men and women. A recent survey of 10,458 community-dwelling men in Sweden revealed a linear relationship between the prevalence of urinary incontinence and age. [2] The overall prevalence of urinary incontinence was found to be 6.1% at 65 years, 9.6% at 75 years, 21.8% for those between 85 and 89, and 28.2% for those aged 90 years and over. A similar study in a cohort of 7949 older women with a mean age of 76.9 ± 5.0 years revealed that 41% reported urinary incontinence, with 14% suffering from daily incontinent episodes. [3] This latter study found the prevalence of urinary incontinence to be strongly associated with age, using multivariate regression analysis (odds ratio [OR] 1.3 per 5 years, 95% CI [confidence interval] 1.2 to 1.5). The authors also found that some common conditions associated with aging are strongly correlated with increased incontinence; these include prior hysterectomy, obesity, history of stroke, chronic obstructive pulmonary disease, diminished gait speed, and poor overall health. This finding supports prior studies that have also demonstrated the relationships between urinary incontinence and other chronic disorders associated with increasing age. [4]

Urinary incontinence can have significant negative impact on self-esteem and has been associated with increased rates of depression. [5,6] Incontinence also affects social aspects of quality of life and activities of daily living. [7,8] It may result in increased dependence on caregivers. Survey data suggest that at least 50% of homebound older adults suffer from urinary incontinence. [9] Those who are incontinent demonstrate significant impairments in social interaction. [10]

Incontinence has been identified as one of the major risk factors that in the United States leads to nursing-home admission, and this relationship has been extensively studied. Using data from the Longitudinal Study on Aging, Coward et al learned that incontinent people in less urbanized or populous areas are more at risk for nursing-home admission than are those in more populous areas. [11] A relative lack of community support services may explain this finding. Other geriatric syndromes that are associated with urinary incontinence can significantly increase the risk of functional dependence. In particular, cognitive impairment and gait abnormalities have been linked to increased rates of both isolated urinary incontinence and combined urinary and fecal incontinence. [12,13] Tinetti et al demonstrated a strong association between urinary incontinence and an increased risk of falls. [14] Seidel et al looked at the relationship between cognition and continence status in an attempt to predict discharge placement after inpatient rehabilitation. [15] They found that analysis of continence and cognitive status at the time of admission to rehabilitation services allows prediction of continence status at discharge that could impact placement decisions.

Even those who are continent at the time of admission to a nursing home have been shown to be at significantly increased risk for the development of urinary incontinence. The estimated

incidence of new-onset urinary incontinence in nursing-home residents is approximately 27% per year. [16] However, age itself has not been identified as a risk factor. In a review of 434 nursing-home residents, Palmer et al identified incontinent episodes or poor behavioral adjustment within 2 weeks of admission, male gender, dementia, or impaired mobility within 2 months as significant risk factors for chronic incontinence in nursing-home residents. [17]

Although urinary incontinence is certainly more prevalent among older adults, it should not be considered a normal or inevitable part of aging. A variety of diagnostic and therapeutic techniques have been developed to address this condition; many have shown great promise for improving or eliminating incontinence even in very elderly persons. In addition, there is an increased awareness of the role of preventive therapies. [18]

Types of Urinary Incontinence

Although urinary incontinence has been operationally defined in a variety of ways, the central feature is considered to be the involuntary loss of urine. This may be either acute or chronic. Urinary incontinence that is acute in onset is often transient and is typically caused by nonurologic factors such as fecal impaction, delirium, or polypharmacy. Correction of the underlying problem often leads to resolution of the urinary incontinence.

There are a variety of forms of chronic urinary incontinence, including stress incontinence, urge incontinence, overflow incontinence, and functional incontinence. Mixed patterns are very common. Determining the type of urinary incontinence an individual has is critically important because type influences the choice and success of a given therapy. Surgical therapies are commonly used to treat stress incontinence and selected patients with urge incontinence.

Stress incontinence is caused by a decrease in outlet resistance at the level of the bladder neck. Leakage occurs when the pressure in the bladder exceeds the outlet closure pressure. Patients describe episodes of incontinence with activities that increase intra-abdominal pressure, such as coughing, sneezing, or laughing. This may be caused by either urethral hypermobility or intrinsic sphincter deficiency. Research has suggested that apoptosis of the rhabdosphincter cells may be one of the primary causes of sphincteric dysfunction in older adults. [19,20]

Urge incontinence is typically caused by overactivity of the detrusor muscles in the bladder wall. Abnormal contractions during bladder filling lead to a sensation of urgency, and if strong enough, these contractions may cause urinary leakage. Urge incontinence is often associated with neurologic disorders, such as prior stroke.

Overflow incontinence is caused by an inability to completely empty the bladder with each voiding attempt. This is often caused by poor detrusor contractility and may be associated with chronic conditions such as diabetes mellitus and some neurologic disorders. Patients typically describe constant dribbling incontinence caused by leakage from the full bladder. Sensation is often diminished, and patients may not sense an elevated postvoid residual volume.

A unique form of incontinence in the elderly population is detrusor hyperactivity with impaired contractility. [21] This is essentially a combination of urge and overflow incontinence. In these

cases, the bladder demonstrates abnormal contractions with filling but diminished contractile function during the voiding effort. It is particularly common in frail elderly persons.

Functional incontinence refers to loss of independent urinary control caused by other functional limitations, such as diminished mobility or cognition. Common causes of mobility limitations include arthritis and gait disturbances. Urinary incontinence seen in people with dementia is often functional in origin.

Nocturia is another very common complaint in older adults and is often associated with functional incontinence. Nocturia can have significant physical and psychosocial impacts, including a higher risk of falls and sleep deprivation. The pathophysiology of nocturia in older adults is still not completely understood.

Diagnostic Evaluation

The evaluation of the patient with urinary incontinence must begin with a detailed history and physical examination. This provides the most valuable information for diagnosis and therapeutic planning. However, a variety of other techniques have been developed, ranging from validated survey instruments to predictive algorithms and sophisticated urodynamic tests. Although these tools are widely employed in the evaluation of the incontinent patient, few studies have examined their utility specifically for the older adult. [22,23]

A large number of both self- and interviewer-administered survey instruments have been designed to assess types and degrees of urinary incontinence. However, there is no clear consensus about which instruments are best or should be used particularly in the geriatric population. One study demonstrated that brief questionnaires may be inaccurate and tend to correlate poorly with urodynamic findings in older adults. [24]

The role of formal urodynamic tests and video imaging studies in the evaluation of geriatric urinary incontinence remains controversial. The World Health Organization convened worldwide consensus conferences on urinary incontinence in 1998 and 2001. A committee focused on geriatric incontinence met at each of these conferences to review and discuss issues related to the evaluation and management of incontinence in older adults. The committee concluded that, although urodynamic studies are generally not required as part of a routine evaluation, they may be particularly important in evaluating geriatric patients being considered for anti-incontinence surgery. [25] These studies can help to differentiate stress, urge, and overflow incontinence, which can affect surgical decisions. Other authors concur with this recommendation for formal urodynamic evaluation prior to development of surgical plans. [26,27] Diokno et al examined the utility of urodynamics in a community-based sample of 167 women aged 60 years and older. [28] In this sample, 26.9% were 70 to 79 years old and 7.2% were 80 years or older. The researchers found that provocative stress tests, including cough and the Valsalva maneuver, significantly distinguish continent from incontinent persons and differentiate between stress and other forms of urinary incontinence. The overall sensitivity and specificity were 39.5% and 98.5%, respectively. Similarly, Wagg et al used urodynamics to identify age-related differences in bladder neck and urethral capacity in older women, including a loss of external sphincter function associated with stress incontinence. [29] Fluoroscopic video imaging is often used with

multichannel urodynamics and may enhance interpretation of results. A study of a group of 69 elderly women (mean age of 72.5 years) revealed voiding cystourethrography to be useful for identifying factors associated with urge incontinence seen on urodynamics. [30]

Treatment

Biobehavioral Therapies. A variety of biobehavioral therapies have been developed to address urinary incontinence, including bladder retraining, pelvic floor muscle exercises, and prompted or assisted voiding routines. These conservative therapies are usually recommended as first-line treatment options, particularly for geriatric patients. [25,31] Although they have been shown to be effective in general, few have been studied in elderly persons. [32] In addition, interpretation and generalization is often difficult because many studies include a heterogeneous population with various forms of urinary incontinence. [31]

Wyman et al performed a randomized clinical trial comparing bladder training with scheduled toileting, pelvic floor muscle exercises, and a combination of the two techniques; their subjects were 204 women with a mean age of 61 ± 10 years who were suffering from stress or urge incontinence, or both. [33] After a 12-week intervention program, the group using the combined treatments was found to have significantly fewer incontinent episodes than did groups using either technique alone. However, at 3-month follow-up, there was no significant difference between groups, suggesting that enrollment in a structured intervention program may be more important than the exact protocol. In a single-arm trial, Publicover and Bear examined the utility of scheduled voiding with weekly clinician counseling. [34] In a group of 19 women aged 64 to 88 years (mean age 75.2), they found that behavioral intervention significantly reduces the number of urinary incontinent episodes during treatment and at 6-month follow-up. The causes and types of incontinence were not defined in this study.

Prompted voiding techniques have also been developed and used successfully with nursing-home residents. [35] Ouslander et al demonstrated an overall response rate of 41% in a cohort of 191 elderly incontinent nursing-home residents (mean age 84.5 years) who underwent a prompted toilet training program. [36] These researchers found that the overall wet percentage went from 26.7% to 6.4% and was sustained at 9.6% after 9 weeks.

Several studies have examined the differences between drug and behavioral therapies. In a randomized controlled trial comparing pelvic floor exercises with biofeedback to anticholinergic medications for treatment of urge incontinence, Burgio et al demonstrated superior results for the behavioral therapy. [37] In this study, 197 women were randomized to behavioral therapy, anticholinergic medication, or placebo. Subjects were 55 to 92 years old (mean age 67.7 ± 7.5 years). Behavioral therapy was found to result in an 80.7% reduction in urge incontinent symptoms; anticholinergics, in only a 68.5% reduction; and placebo, in 39.4% (all, $P < .05$). In a subsequent modified crossover trial, the same researchers found that, in a cohort of 35 women aged 55 to 91 years (mean 69.3 ± 7.9), the combination of oxybutynin and pelvic floor exercises supplemented with biofeedback is successful in reducing urge incontinent episodes by 84.3% to 88.5%. [38] In comparison, women on medication or behavioral therapy alone demonstrated improvements of 57.5% to 72.7%. Szonyi et al found similar results in a randomized, double-blind, controlled trial with 57 elderly subjects aged 72 to 98 years (mean 82.2 ± 6.06). [39] The

overall efficacy of the combination of oxybutynin and behavioral therapy was found to be superior to that of placebo or of either medical or behavioral therapy alone.

Pharmacotherapy. Pharmacotherapy has been widely used to treat urinary incontinence, particularly for the treatment of urge incontinence. The most commonly used medications for urge incontinence are anticholinergics; examples are oxybutynin and tolterodine. Both have shown efficacy in older adults, but their use can be associated with significant side effects, including dry mouth, constipation, blurred vision, and confusion. Newer drugs currently in development are more uroselective and may have fewer systemic side effects in older adults.

Few pharmacologic agents are available for the treatment of stress incontinence. Phenylpropanolamine was used in the past to treat some patients with mild stress urinary incontinence. However, the U.S. Food and Drug Administration recently removed this drug from the market because of an associated increased risk of stroke. At this time, the only medication that shows some efficacy in the treatment of stress incontinence is topical vaginal estrogen. Published results are somewhat controversial, and there is a large amount of conflicting data. Data on geriatric cohorts is extremely limited, and many studies are confounded by heterogeneous subject demographics, outcomes measurements, and diagnostic criteria. However, a meta-analysis by Fantl et al did present supportive evidence that estrogen replacement subjectively improves urinary incontinence symptoms in postmenopausal women. [40]

Complementary Therapy. To date, there have been almost no studies examining the role of complementary therapies in the treatment of urinary incontinence in elderly persons. However, interest in such treatments is likely to increase. One uncontrolled pilot study examined the outcomes of acupuncture in a group of 15 elderly women with urge or mixed urinary incontinence that was refractory to other behavioral or medical therapies. [41] Mean age was 76.4 years (range 66 to 82). All subjects underwent 12 acupuncture treatments over a 6-week period. Twelve of the 15 women (80%) considered themselves significantly improved at 3-month follow-up.

Surgery. Surgical therapy has long been a mainstay of treatment, particularly for stress urinary incontinence. It is widely used in treating younger women, but there is some hesitation to choose surgery for older women. Most agree that the first line of treatment for stress incontinence in older women, particularly those who are frail, should be conservative therapy. [25] Although there is a plethora of data on the indications, efficacy, and potential complications of a wide variety of surgical procedures for the treatment of stress urinary incontinence, very little research has focused on the geriatric patient. Most published studies include a wide range of patients, and it is often difficult to extract results specific to older adults. Research in this field is also hampered by a lack of standardized diagnostic criteria, terminology, and outcomes measures. In addition, there is a dearth of well-designed randomized trials that directly compare the various forms of surgery such as bladder neck injection of bulking agents, retropubic or transvaginal bladder neck suspensions, or pubovaginal sling procedures. Many studies have short-term follow-up of 1 or 2 years, and they often lack information regarding specific reporting intervals. A number of leading professional organizations, including the American Urological Association, the International Continence Society, and the World Health Organization, have identified these

limitations in the available research and have made recommendations to improve the quality of future studies. [25,42,43]

The risks of morbidity and mortality for geriatric patients undergoing anti-incontinence surgery are similar to those of other major surgical procedures. In a review of 66,478 Medicare patients, Sultana et al found the overall postoperative surgical mortality to be 0.3% at 30 days, 0.5% at 60 days, and 0.6% at 90 days. [44] The mean and median patient age in this cohort was 71 years. The risk of significant postoperative morbidity and mortality was found to increase linearly with age. In the group aged 75 to 84 years, the mortality rates were 0.5%, 0.7%, and 0.9% at 30, 60, and 90 days, respectively. In the cohort of those 85 years and older, the postoperative mortality rates were 1.6%, 2.0%, and 2.3%, respectively. Median length of hospital stay and readmission rates were also somewhat higher in this older cohort. However, in a multivariate analysis age was not identified as an independent risk factor for morbidity or mortality. The authors concluded that anti-incontinence surgery can be done safely in all age groups, and that the associated comorbidities in very elderly persons are likely more significant contributors to postoperative morbidity and mortality than is age itself.

Injection therapy represents an effective, minimally invasive surgical treatment for stress urinary incontinence caused by intrinsic sphincter deficiency. The procedure can be performed under local or general anesthesia. A bulking agent is injected into the submucosal space at the level of the bladder neck with the use of cystoscopic guidance. Although a variety of materials have been used for the injections, the most widely used material is glutaraldehyde cross-linked collagen. The material acts to increase outlet pressure at the bladder neck. Overall success is approximately 80% in women and 15% in men. Many patients need repeat injections over time to maintain continence. Most studies include a diverse range of patient ages, but the treatment appears to be effective in older women. One study examining the response to collagen injection in elderly women reported a 77% cure rate at 2 years of follow-up (mean age 76 years, range 62 to 90). [45] The procedure is minimally invasive and repeatable, which makes it attractive for use in older adults. Most studies have found that age does not correlate with outcomes for injection therapy. [46-48]

Open surgical procedures for female stress incontinence include bladder neck suspensions or pubovaginal slings. The suspension procedures may be performed via either a transvaginal or retropubic approach. Several studies have examined the utility of these procedures in elderly women. Nitti et al retrospectively examined the results of the Raz transvaginal suspension procedure in 92 women aged 65 to 87 years (mean 72 years). [49] At a mean of 17 months of follow-up, the overall success rates were 100% for those with mild incontinence, 93% for those with moderate incontinence, and 65% for those with severe incontinence. The researchers compared these results with those from a cohort of 141 patients younger than 65 years. Overall, they found similar continence and complication rates in the two groups. They concluded that this procedure can be done safely and effectively for patients regardless of age.

Pubovaginal sling procedures are being used in increasing numbers for the treatment of female stress urinary incontinence. In contrast to suspension procedures, which place sutures in the periurethral tissues and suspend the urethra to decrease its hypermobility or angulation, sling procedures place a supportive graft underneath the urethra. The procedure has been shown to be

effective for stress incontinence caused by either urethral hypermobility or intrinsic sphincter deficiency. Carr et al looked at the results of pubovaginal sling in a retrospective cohort of 19 elderly women (median age 72 years, range 70 to 82). [50] The researchers compared their results with those in a group of 77 women with a median age of 60 years (range 26 to 69). The overall morbidity and success rates of the sling procedure were equivalent in the two groups. Stress incontinence had been resolved in 100% of the older women and 97% of the younger women at a mean follow-up of 22 months. No patients developed significant urinary retention, and the rate of postoperative urinary urgency was 10% in both groups. The researchers concluded that pubovaginal sling cystourethropexy is a safe and effective surgical option for both older and younger women.

Tension-free vaginal tape is a new procedure that uses a synthetic mesh for the suburethral sling. To date there have been limited studies on its use, and follow-up is quite short. However, the short-term data do demonstrate good continence outcomes even in elderly patients. [51] Longer term follow-up in a larger sample will be necessary, as synthetic materials are prone to increased rates of urethral erosion and infection.

Needed Research in Urinary Incontinence

Future studies need to include standardized operational definitions for urinary incontinence, a clear separation of the types of incontinence included in the study population, and requirements for patient inclusion and exclusion.

Although a number of survey instruments are currently used to evaluate patients with incontinence, few have been developed or validated for use in older adults. In the area of diagnostic evaluation, there is a need to better define the role of formal urodynamic testing, including videourodynamics in the assessment of older patients with urinary incontinence. This is particularly important for those considered as surgical candidates.

Urinary incontinence and pelvic organ prolapse often coexist in older women. Additional research on the diagnosis and management of prolapse in older women is needed, particularly to help define the role of surgical therapy in this population.

Several sets of clinical guidelines have been developed for the evaluation and management of urinary incontinence. Formal outcomes research is needed to identify the utility of these guidelines in both institutionalized and community-dwelling older adults.

Although there has been some research examining the association between urinary incontinence and other chronic health conditions in older adults, more work is needed to better understand these complex interactions. Examination of the relationship between urinary incontinence and other functional impairments, such as cognitive and physical limitations, will be particularly important. Urinary incontinence is commonly associated with chronic neurologic conditions, such as stroke, Parkinson's disease, multiple sclerosis, and Alzheimer's disease. The urologic implications of these disorders, particularly for rehabilitation outcomes, are still relatively poorly understood. In addition, there is a need for additional work on the urologic outcomes in geriatric patients with spinal cord injuries.

Research on behavioral techniques and pharmacotherapy for urinary incontinence must include older adult subjects. Ideally, these treatments should be analyzed for evidence of age-related effects. Studies should also include a variety of subjects, including community-dwelling older adults and people residing in assisted-living and long-term-care environments.

Studies regarding surgical therapy for urinary incontinence should examine outcomes, including potential complications in older adults. Although short-term studies are necessary to begin this work, long-term data will be required to fully evaluate the risks and benefits of anti-incontinence surgeries in older patients. Ideally, this would include 5- to 10-year follow-up with both subjective and objective outcomes measures. Standard surgical techniques, such as injection of bulking agents at the bladder neck, bladder neck suspension procedures, pubovaginal sling cystourethropexy, and artificial urinary sphincter placement, need to be examined in older patient populations in a prospective fashion, with an appropriate length of follow-up.

New anti-incontinence surgical techniques are being developed for both men and women. Many of these procedures are minimally invasive, and they have the potential to offer good clinical outcomes with less surgical risk. However, they need to be studied in comparison with currently accepted procedures. Prospective randomized trials that include older adults in a subgroup analysis would be the ideal. Innovative surgical techniques for urge incontinence such as sacral nerve stimulator implantation also need to be studied in a prospective fashion in this patient population.

Quality of life and cost must be considered in the evaluation and treatment of urinary incontinence in older adults. These types of studies help to define clinical needs from a social standpoint. Ultimately, this information helps to shape decisions about health care policy and reimbursement.

Urol 1 (Level B): **Studies are needed on the pathophysiology of nocturia, which occurs in a wide variety of conditions, including heart failure, renal failure, vascular insufficiency, sleep disorders, prostate enlargement, and polyuria of various causes.**

Urol 2 (Level B): **Studies are needed to establish the validity of new and existing survey instruments to assess the types and degrees of urinary incontinence in older adults.**

Urol 3 (Level B): **Systematic prospective cohort or case-control studies are needed to determine whether urodynamic and imaging techniques are associated with better outcomes in urinary incontinence in older patients.**

Urol 4 (Level A): **Depending on the results of studies of the impact of urodynamic and imaging techniques on outcomes (Urol 3), the effect of particular urodynamic or imaging studies on the accuracy of diagnosis and outcomes of treatment should be assessed in randomized controlled trials.**

Urol 5 (Level A): **Further randomized controlled trials are needed to test the efficacy and safety of both new and established anticholinergic drugs for the management of urinary incontinence in older adults.**

Urol 6 (Level A): **Randomized controlled trials with large numbers of subjects will be required to determine whether acupuncture or other complementary therapies have a significant beneficial effect in treating urge or mixed urinary incontinence in older patients.**

Urol 7 (Level A): **The bladder neck suspension and sling procedures have been proven effective in older women studied an average of 17 months after surgery. Prospective cohort studies with longer-term follow-up periods are needed to determine whether these procedures have sustained longevity.**
Urol 8 (Level B): **Prospective cohort studies are needed to explore the factors that identify which elderly patients will do better with early surgical intervention than with more conservative treatment options.**
Urol 9 (Level A): **Performing randomized controlled trials to extend the studies of factors that identify appropriate candidates for early surgery for incontinence could lead to the development and validation of predictive models useful for guiding treatment decisions for various types of urinary incontinence in older patients (see also Key Research Questions in Geriatric Urology, end of chapter).**

URINARY TRACT INFECTIONS

UTIs and asymptomatic bacteruria are common in older adults, particularly those in long-term-care settings. Although there is consensus that symptomatic infections should be treated with antibiotics, the implications of recurrent infections and asymptomatic bacteruria on long-term morbidity and mortality outcomes are more controversial. In a prospective cohort study of 1491 women, Abrutyn et al did not find UTI to be a risk factor for mortality. [52] In contrast, they did find age and poor self-reported health status to be significant predictors of mortality. However, a previous longitudinal cohort study of 1148 men and women reported by Nordenstam et al did demonstrate a significant increase in 5-year mortality for men with bacteruria. [53] The similar finding in women disappeared when those with indwelling catheters were excluded from the analysis. In contrast, Nicolle et al reported no significant survival difference between men with and without asymptomatic bacteruria. [54]

Bacteruria has been shown to be a transient phenomenon in older adults. Monane et al performed a prospective observational study on 61 women. [55] Subjects included both community-dwelling persons and long-term-care residents. The researchers found asymptomatic bacteruria to be present in 20% of all urine samples and in one third of all subjects over 6 months of follow-up. Variation was seen on a month-by-month basis, with frequent spontaneous alterations in positive and negative specimens.

These data support the consensus that asymptomatic bacteruria in the older adult does not usually warrant initiation of antibiotic therapy. In a randomized trial of antibiotic treatment for 50 institutionalized elderly women (mean age 83.4 ± 8.8 years) with asymptomatic bacteruria, Nicolle et al found no short-term benefits to be associated with therapy. However, they did identify increased long-term risks, including reinfection with resistant organisms. [56] Similarly, Ouslander et al found that treating asymptomatic bacteruria in institutionalized elderly women does not improve rates of chronic urinary incontinence. [57]

Bacteruria is also commonly associated with chronic indwelling catheter use and typically does not require treatment. However, UTIs associated with short-term catheterization of less than 2 weeks in older adults should be addressed. In a prospective randomized controlled trial, Harding et al examined the role of antibiotic therapy in a group of 119 women with catheter-acquired

UTIs [58] and found that infections resolve spontaneously more often in younger women than in those aged 65 years or older (89% versus 62%;$P < .001$). They also found that single-dose antibiotic therapy is generally effective, although more so in the younger women.

Raz et al examined the risk factors associated with recurrent UTI in a case-control study of 149 postmenopausal women referred for evaluation and treatment of UTIs. [59] Compared with the 53 age-matched control subjects, the case subjects tended to have at least one of three common urologic conditions believed to predispose them to infection: urinary incontinence (41% versus 9%, $P < .001$), cystocele (19% versus 0%, $P < .001$), and elevated postvoid residual urine volume (28% versus 2%, $P < .001$). Age was not identified as a significant risk factor in this study.

Two studies have shown the prevalence of UTI in hip fracture patients to be approximately 23% to 25%. [60,61] Catheterization was not found to be a significant risk factor. However, female gender, prior history of UTIs, poor general medical health, and delay in operative treatment of the fracture were found to be predictors of UTI. The identification and treatment of UTIs in this patient population are also important to help prevent potential infection of implanted orthopedic prostheses.

Vaginal estrogen replacement has long been a mainstay of therapy for the prevention of recurrent UTIs in postmenopausal women. [62] Many patients find cream-based preparations messy and uncomfortable. A recent randomized open, parallel study by Eriksen revealed good response to an estrogen-impregnated vaginal device (Estring). [63] Its use has not been studied in a geriatric population; however, improved satisfaction could lead to increased adherence by older patients.

Cranberry juice and other cranberry preparations have long been used as prophylactic treatments for recurrent UTIs. It is hypothesized that cranberries contain compounds that prevent bacterial adhesion to the urothelium. Studies support the prophylactic use of cranberry products, particularly in institutionalized older adults. [64] Avorn et al performed a randomized, double-blind, placebo-controlled trial with 153 older women (mean age 78.5 years). [65] Consumption of 300 mL of cranberry juice each day was found to reduce the odds of clinically significant bacteriuria ($\geq 10^5$ organisms) with associated pyuria to 42% of that seen in the control subjects ($P = .004$). In another study, Kontiokari et al compared consumption of cranberry-lingonberry juice, *Lactobacillus GG*, and placebo in a group of 150 women previously diagnosed with acute *Escherichia coli* UTIs. [66] They found a 20% reduction in the absolute risk of recurrent UTI (defined as a urine culture with $\geq 10^5$ colony-forming units of bacteria) for the women who drank the juice in comparison with the control group ($P = .023$, 95% CI = 3% to 36%). The recurrence rate for those who consumed *Lactobacillus* did not differ from that of the control group in this series.

Most research on UTIs in older adults has examined patient risk factors and the bacteriology associated with infection. Studies are often confusing because they lack detailed information on what constitutes an infection. The definition of asymptomatic bacteruria is especially a problem. Future research studies must clearly state the inclusion and exclusion criteria used for subject selection.

Clinical drug studies of new antibiotic agents need to consider the unique needs of older adults. They must include issues of safety, efficacy, and tolerability in this patient population. Special attention must be paid to drug-drug interactions and the issue of poly-pharmacy. Studies on the epidemiology of infection are needed, particularly with regard to development of resistant pathogens. Research on prophylaxis should include specific analysis of indications and outcomes in older adults.

Urol 10 (Level B): **Additional research is needed to clarify the operational definitions of urinary tract infection and of asymptomatic bacteruria.**
Urol 11 (Level B): **The natural history and potential risks of urinary tract infection or asymptomatic bacteruria and forms of preventive therapy warrant further study (see Key Research Questions in Geriatric Urology, end of chapter).**
Urol 12 (Level A): **Research on new antibiotic agents for the treatment of urinary tract infection should include randomized controlled trials specifically designed to assess the safety and efficacy of these drugs in geriatric patient populations.**