



ELSEVIER

OFFICE MANAGEMENT: GERIATRICS

Michael W. Rich, MD, Speciality Editor

Falls in Older Adults: Risk Assessment, Management and Prevention

Kyle C. Moylan, MD,^a Ellen F. Binder, MD^b

^aDepartment of Internal Medicine, Division of General Internal Medicine, University of Missouri–Columbia School of Medicine, Columbia; ^bDepartment of Medicine, Division of Geriatrics and Nutritional Science, Washington University School of Medicine, St. Louis, Mo.

ABSTRACT

Falls are a common and serious problem for older adults. This article reviews practical aspects of the evaluation and management of this disorder in the ambulatory setting. Older patients should be screened for falls or changes in mobility as part of their annual health maintenance examination. Most falls are due to multiple factors, including disorders of gait, balance, strength, and vision. Polypharmacy and certain medications contribute to falls in many patients and can be a remediable factor. Many falls can be prevented through individualized multicomponent interventions. Exercise programs, rehabilitation, medication management, and treatment of vitamin D deficiency are the most effective single interventions. Referral to a geriatrician should be considered for patients with other common geriatric syndromes, such as cognitive impairment, incontinence, or depression. © 2007 Elsevier Inc. All rights reserved.

KEYWORDS: Balance; Gait; Falls; Mobility; Polypharmacy

Nearly one third of people aged 65 years or older fall each year, with consequences ranging from mild to severe. One half of these patients fall more than once. The risk of falls increases substantially with age, as does the risk of serious injury with each fall. Approximately 10% to 15% of falls result in serious injuries, and unintentional injuries are estimated to be the fifth most common cause of death in older adults. Many serious injuries are due to fractures, most notably hip fractures, and up to 75% of hip fracture patients will not regain their prior level of function. Patients hospitalized for a fall also are at high risk for subsequent disability and nursing home placement. Other serious consequences of falls include head injuries, pain, restriction of mobility, fear of recurrent falls, depression, and social isolation.

Fear of falling can be a particular problem for older patients. Patients who fall often limit their activity, which leads to further functional decline, muscle weakness, dis-

ability, and risk of further falls. These patients often fear losing their autonomy and may not volunteer information about restricted mobility or falls to their family or physician.

The multifactorial nature of falls cannot be overemphasized. Successful ambulation depends on the complex integration of cognitive, neuromuscular, sensory, and skeletal components. Each of these systems may be affected as a consequence of degeneration or disease with advancing age. Medical conditions and medications associated with falls are listed in [Tables 1](#) and [2](#). Many important risk factors for falls can be modified, such as polypharmacy, visual impairment, pain, proximal muscle weakness, and gait and balance problems. A systematic approach based on available evidence can effectively reduce the incidence of falls and resultant injuries, but the first step is to identify patients most at risk. In this regard, quality indicators have recently been established for the evaluation, management, and prevention of falls.¹

Requests for reprints should be addressed to Kyle C. Moylan, MD, Division of General Internal Medicine, University of Missouri-Columbia, 1 Hospital Drive, DC043.00, Columbia, MO 65212.

E-mail address: moylank@health.missouri.edu

CLINICAL PRESENTATION

A fall is defined as any unintentional positional change that results in the patient coming to rest on the ground, floor, or

Table 1 Medical Conditions Associated with Falls

Neurological disorders	Stroke Parkinsonism and other movement disorders Gait disorders Vestibular disorders Dementia Delirium
Musculoskeletal disorders	Osteoarthritis Joint deformities Kyphosis Muscle weakness Podiatric conditions
Sensory abnormalities	Visual impairment Hearing impairment Peripheral neuropathy
Cardiovascular disease	Orthostatic hypotension Sinoatrial dysfunction Arrhythmias Syncope
Chronic medical conditions	Anemia Diabetes mellitus Lung disease Sleep disorders Depression
Medications	See Table 2 Polypharmacy (≥ 4 medications)
Miscellaneous Conditions	Alcohol Use Recent hospitalization Acute medical illness

other lower surface. Those at highest risk are likely to have other “geriatric syndromes,” such as depression, cognitive impairment, polypharmacy, orthostatic hypotension, gait abnormalities, sensory impairment, and social isolation. All nursing home patients should be considered at high risk for falls.

Ideally, patients at risk for falls should be identified and modifiable risk factors addressed before any serious injury. Because most falls do not result in serious injuries, practitioners should specifically inquire about falls or changes in mobility as part of an annual health maintenance examination. Two or more falls in 6 months, any fall resulting in serious injury, or fear of falling should trigger a complete evaluation and appropriate interventions as outlined in the [Figure](#). Postfall evaluations with targeted interventions have been shown to reduce the risk of subsequent falls.^{2,3} Older hospitalized patients also should undergo a fall risk evaluation with a fall prevention plan as part of their discharge care.

Because many older patients may not remember having fallen or may not report falls for other reasons (eg, embarrassment or fear of loss of autonomy), physicians should be alert to other signs that may indicate falls. These include unexplained bruises (which also can be a sign of elder abuse), altered cognition, personality changes, or disturbances in gait or balance.

EVALUATION

The evaluation of a patient who has fallen or is at high risk for falls should be targeted to identify modifiable factors. The circumstances of any fall should be elicited to help focus the evaluation. Associated symptoms may suggest that the fall was a manifestation of an acute medical illness (eg, pneumonia or heart failure), as the elderly often have atypical and nonspecific clinical presentations. Falls related to syncope are a discrete entity that warrants an evaluation directed at potential cardiovascular or other causes. Other medical conditions that may contribute to falls are listed in [Table 1](#). Restricted mobility related to pain, dyspnea, or other treatable conditions also may predispose to falls. Medications often play a role ([Table 2](#)) and can be one of the simplest risk factors to modify. Many of the medications associated with falls also are identified by the Beers criteria as potentially inappropriate for older adults.⁴ Psychoactive and sedative-hypnotic medications, particularly those with a long half-life, are most often linked with falls. Cardiovascular drugs also are frequently implicated, most often related to volume depletion or postural hypotension. The absolute number of medications also correlates with the risk of falls. Some commonly used over-the-counter medications also may be implicated, for example, diphenhydramine.

A comprehensive physical examination is an essential part of the evaluation; office staff may be trained to help perform components of the examination to maximize efficiency. Vital signs, orthostatic blood pressure measurement, and body weight should be obtained. A decrease in height of 2 inches or more may indicate osteoporosis and should trigger appropriate management. A vision examination should be performed, and referral to a specialist should be considered if vision is impaired or other eye problems are suspected. A neurological examination should be performed to assess muscle strength and cerebellar function, and to evaluate for a peripheral sensory neuropathy. A screening test for cognitive impairment, such as the Mini-Mental State Examination or Short Blessed Test,

Table 2 Medications Frequently Associated with Falls by Class

Class	Specific Agents
Benzodiazepines	Chlordiazepoxide, diazepam, alprazolam
Antidepressants	Amitriptyline, nortriptyline, fluoxetine
Anitpsychotics	Fluphenazine, chlorpromazine, haloperidol, risperidone
Antiepileptics	Phenytoin, phenobarbital
Anticholinergics	Diphenhydramine, hyoscyamine, tolterodine, oxybutynin
Sedative hypnotics	All barbiturates, zolpidem, zaleplon
Muscle relaxants	Cyclobenzaprine, metaxalone, methocarbamol
Cardiovascular medications	Diuretics, doxazosin, terazosin, clonidine, digoxin

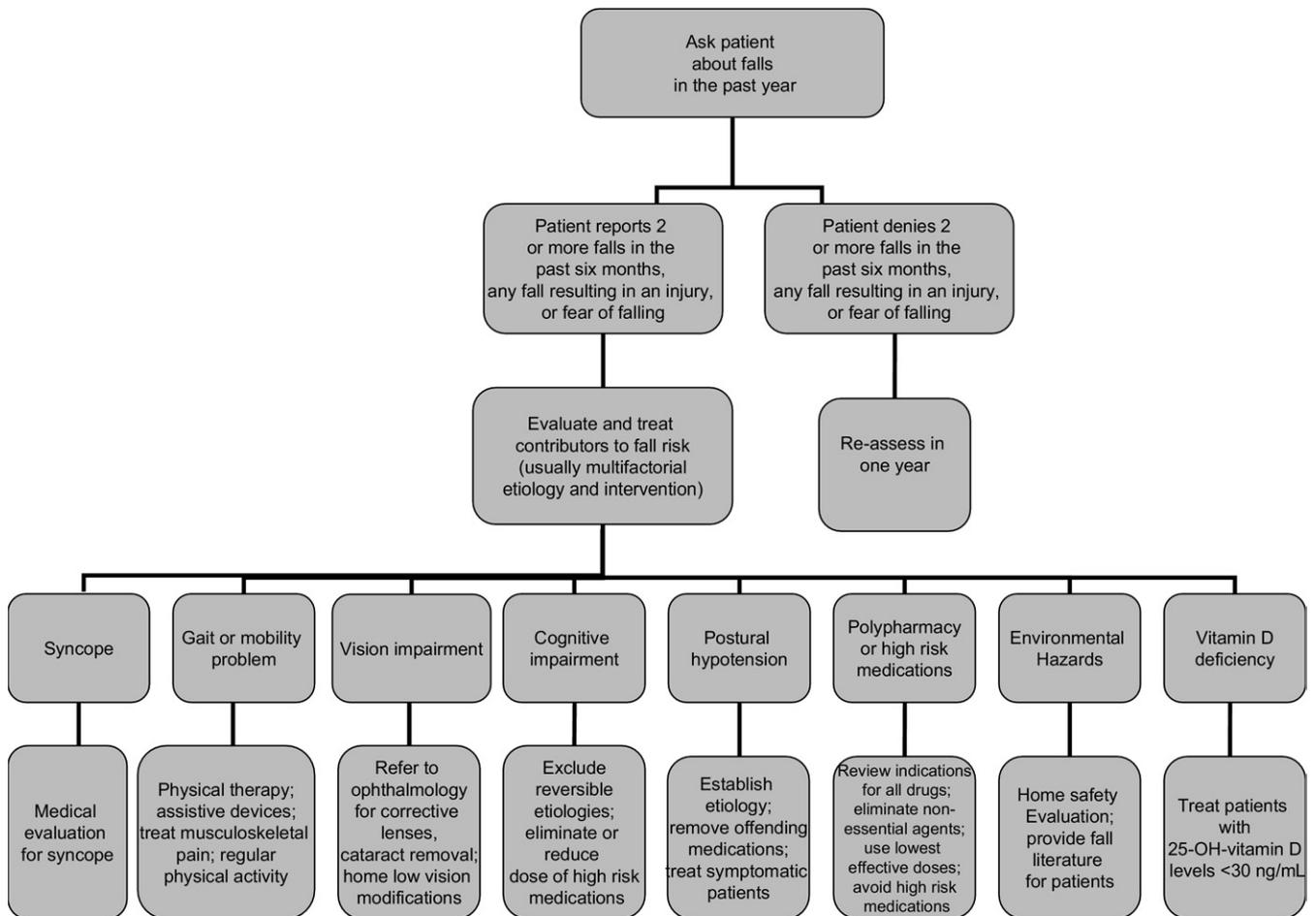


Figure Algorithm outlining the approach to fall prevention in older adults.

should be performed (see resources for health professionals in the [Appendix](#) available online).

Proximal muscle weakness of the lower extremities, a common and modifiable risk factor for falls, can be ascertained by asking the patient to stand from a seated position 5 times without the use of hands. Taking more than 11 seconds to complete the task may indicate muscle weakness. Balance can be assessed with a progressive Romberg or single-limb stance time. Gait should be assessed, paying careful attention for signs of Parkinsonism or other abnormalities. More commonly, patients will have subtle changes in gait and balance that may be evident when the patient makes a turn or is distracted by another simultaneous task. A brief standardized method for gait assessment is the “get-up-and-go” test⁵; patients are instructed to stand from a seated position, walk 10 feet, turn around, return to the chair, and sit down. In addition to the general information obtained from observing the patient’s gait and mobility, patients who take more than 30 seconds to complete the test are at higher risk for falls and disability. The web resources listed in the [Appendix](#) (online) include multimedia websites that demonstrate these maneuvers.

Laboratory evaluation is performed as directed by the history and physical examination. A comprehensive metabolic panel (electrolytes, kidney function, and liver function tests) and complete blood count should be considered to assess for metabolic abnormalities, anemia, and nutritional deficiencies. Vitamin D adequacy can be measured by the 25-hydroxyvitamin D level. Serum thyroid-stimulating hormone (TSH), B₁₂ and folate levels should be obtained if there is evidence of neuropathy or cognitive impairment. Bone mineral density assessment should be performed to assess for osteoporosis and increased fracture risk.⁶ An electrocardiogram is usually not necessary in the absence of syncope or suspected cardiac cause of falls (eg, an arrhythmia).

MANAGEMENT

Because most falls are multifactorial in origin, single interventions tend to be of limited efficacy. Conversely, using complex and multifaceted interventions for every patient is inefficient and wasteful. Therefore, management should be directed to the patient’s unique situation.^{7,8} The risk/benefit profile of prescribed and over-the-counter medications

should be weighed carefully, with the goal of reducing the absolute number of medications, utilizing the lowest effective doses, and eliminating medications that are specifically associated with falls. Lifestyle and nonpharmacologic approaches to common geriatric problems may be helpful for reducing medication use (such as promoting sleep hygiene methods for insomnia or behavioral interventions for incontinence).

In general, patients should be encouraged to remain physically active to prevent falls and functional decline. When possible, patients should be directed to specific programs that suit their needs and preferences. Patients with deficits in strength, balance, or mobility will benefit most from physical and occupational therapy services. Specific rehabilitation programs are often available for patients with cerebrovascular disease, Parkinson's disease, and vestibular disorders. Tai chi is an effective intervention for reducing falls,⁹ but its implementation may be limited by a lack of access and reimbursement by insurers. Women with significant kyphosis may benefit from postural training; one such program using a postural-training device demonstrated improved gait parameters and a reduction in falls and back pain.¹⁰ Assistive devices, such as a cane or walker, can be helpful but, if inappropriate for the patient's physical impairment, they may actually increase the risk of falls. The specific device should be selected and fitted to the patient's needs with the help of a physical therapist or prosthetist.

Environmental factors often interact with patient-related factors to induce a fall. Physicians rarely have the opportunity to observe the environmental hazards present in the patient's home, where most falls occur. Many communities have occupational therapy services with home programs designed to assess and modify environmental risk factors for falls in the home such as cluttered walkways, electrical cords, loose rugs, and other identifiable problems. Patients with impaired vision may benefit from modifications to improve lighting and increase visibility of hazards, and these services may be offered by local programs for the blind or visually impaired if a home fall program is not available. Nighttime falls may be reduced by proper lighting, reducing nocturia, avoiding bedtime sedatives, and use of a bedside commode (if walking to the bathroom is unsafe). Patients should be encouraged to wear supportive, non-slip shoes with a low heel and to avoid wearing slippers or going barefoot.

Correcting vitamin D deficiency with high doses of ergocalciferol has been shown to be an effective and low-risk intervention for improving balance and reducing falls in some studies. A dose of 50,000 units orally per week to maintain levels above 30 ng/mL is a reasonable strategy based on currently available data.¹¹⁻¹³ Appropriate diagnosis and management of osteoporosis is recommended,⁶ although this alone is insufficient for preventing falls and fractures.

Hip pads are an attractive treatment option to reduce the risk of hip fracture resulting from a fall. Although some

studies have shown them to be effective,¹⁴ no product is currently available and Food and Drug Administration approved for this indication. Many nursing homes have instituted programs using these simple devices, but many questions remain regarding the optimal device and target population.

SPECIFIC CONCERNS

Older adults who fall while taking anticoagulants pose a particularly difficult problem for clinicians. The primary concern is the risk of intracranial hemorrhage, most commonly subdural hematoma. Often, older patients are at high risk for adverse outcomes related to the underlying condition (stroke from atrial fibrillation, or recurrence of venous thromboembolism). The indication for anticoagulation should be re-assessed, as patients with prior deep venous thrombosis may have completed the recommended duration of therapy. For patients at risk for cardioembolic stroke, anticoagulation should not necessarily be discontinued based on a single fall. The actual increased risk of intracranial hemorrhage while on warfarin is difficult to assess, but is frequently overestimated by clinicians. Recurrent falls or head injury resulting from a fall may unfavorably alter the risk/benefit profile associated with anticoagulation. The patient should play an active role in this discussion.

Concern about falls often triggers consideration of the patient's safety in their current living situation. Patients may require more supervision than is possible in the present setting. Patients who live alone and are unable to get up after a fall are at risk for dehydration, rhabdomyolysis, renal failure, decubitus ulcers, and death. Medical alert devices such as Lifeline (Philips Electronics North American Corporation; New York, NY) may be helpful, but patients with impaired cognition may not be able to use them properly when a fall occurs. Nursing home placement is not necessarily the answer to falls prevention, as falls occur frequently in the nursing home setting. Assisted living and lesser levels of care such as senior apartments often provide a service whereby patients are checked daily. These settings also may provide access to exercise classes or other interventions to maintain physical activity, mobility, and balance.

Of note, the current reimbursement system for physicians does not provide a specific ICD-9 code for the diagnosis of falls. Specific diagnoses related to falls may be used, such as gait abnormality, muscle weakness, and adverse effect of medications.

REFERRAL

Referral to a subspecialist should be considered for some patients. Geriatricians can be helpful for providing a comprehensive assessment, particularly when other geriatric syndromes are present that contribute to falls, such as cognitive impairment, incontinence, or depression. This often includes multidisciplinary team management that integrates

physical therapists and social workers, and which can prove beneficial for many patients. Consultation with a neurologist, cardiologist, or physical medicine and rehabilitation specialist may be indicated based on the patient's comorbidities.

References

1. Rubenstein LZ, Powers CM, MacLean CH. Quality indicators for the management and prevention of falls and mobility problems in vulnerable elders. *Ann Intern Med.* 2001;135:686-693.
2. Becker C, Kron M, Lindermann U, et al. Effectiveness of a multifaceted intervention on falls in nursing home residents. *J Am Geriatr Soc.* 2003;51:306-313.
3. Tinetti ME, Baker DI, McAvay G, et al. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *N Engl J Med.* 1994;331:821-827.
4. Fick DM, Cooper JW, Wade WE, et al. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Arch Intern Med.* 2003;163:2716-2724.
5. Podsiadlo D, Richardson S. The timed 'Up & Go': a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc.* 1991; 39:142-148.
6. Wilkins CH, Birge SJ. Prevention of osteoporotic fractures in the elderly. *Am J Med.* 2005;118:1190-1195.
7. Tinetti ME. Preventing falls in elderly persons. *N Engl J Med.* 2003; 348:42-49.
8. Chang JT, Morton SC, Rubenstein LZ, et al. Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomised clinical trials. *BMJ.* 2004;328:680-683.
9. Wolf SL, Barnhart HX, Kutner NG, et al. Reducing frailty and falls in older persons: an investigation of Tai chi and computerized balance training. *J Am Geriatr Soc.* 2003;51:1794-1803.
10. Sinaki M, Brey RH, Hughes CA, et al. Significant reduction in risk of falls and back pain in osteoporotic-kypnotic women through a Spinal Proprioceptive Extension Exercise Dynamic (SPEED) program. *Mayo Clin Proc.* 2005;80:849-855.
11. Bischoff-Ferrari HA, Dawson-Hughes B, Willett WC, et al. Effect of vitamin D on falls: a meta-analysis. *JAMA.* 2004;291:1999-2006.
12. Dhesi JK, Moniz C, Close JC, Jackson SH, Allain TJ. A rationale for vitamin D prescribing in a falls clinic population. *Age Ageing.* 2002; 31:267-271.
13. Latham NK, Anderson CS, Reid IR. Effects of vitamin D supplementation on strength, physical performance, and falls in older persons: a systematic review. *J Am Geriatr Soc.* 2003;51:1219-1226.
14. Kannus P, Parkkari J, Niemi S, et al. Prevention of hip fracture in elderly people with use of a hip protector. *N Engl J Med.* 2000;343:1506-1513.

Appendix Resources

For patients

AARP's website provides useful patient information on fall prevention, including additional resources and books.

http://www.aarp.org/health/staying_healthy/prevention/better_balance_prevents_falls.html

OASIS serves numerous cities across the United States with exercise classes and other activities for older adults.

<http://www.oasisnet.org/index.htm>

The CDC toolkit includes fact sheets and brochures for patients (available in English or Spanish).

<http://www.cdc.gov/ncipc/pub-res/toolkit/toolkit.htm>

The American Geriatrics Society provides patient education materials on their website.

<http://www.americangeriatrics.org/staging/education/falls.shtml>

For health professionals

The American Geriatrics Society website provides numerous tools for managing falls, including sample office forms and a description of the "get up and go" test.

<http://www.americangeriatrics.org/staging/products/positionpapers/abstractPF.shtml>

<http://www.americangeriatrics.org/staging/education/falls.shtml>

http://www.americangeriatrics.org/staging/education/01_initial_visit.pdf

http://www.americangeriatrics.org/staging/education/02_get_up_go_test.pdf

The University of Miami's GeriU website provides an interactive module that demonstrates the Tinetti Balance and Gait Evaluation.

<http://www.geri.ufl.edu/angel/uploads/applications/tinetti/tinetti.htm>

The University of Utah's website includes excellent tutorials on the neurological examination, with demonstration of prototypical gait abnormalities.

http://medlib.med.utah.edu/neurologicexam/html/gait_abnormal.html

The website for the American Medical Director's Association (AMDA) has extensive information on addressing falls in the nursing home, including a CME program.

<http://www.amda.com/tools/clinical/falls.cfm>

The University of Iowa offers extensive online geriatrics education material, including cognitive screening tests such as the MMSE, as well as information on falls.

<http://www.medicine.uiowa.edu/igec/tools/categoryMenu.asp?categoryID=1>

A copy of the Short Blessed Test can be found on the Washington University Internet Stroke Center website.

<http://www.strokecenter.org/trials/scales/somct.html>