SPECIAL ARTICLE

Practice Parameter: Assessing patients in a neurology practice for risk of falls (an evidence-based review)

Report of the Quality Standards Subcommittee of the American Academy of Neurology

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ABSTRACT

Objective: To develop a practice parameter for screening methods and assessments of risk for falls pertaining to patients likely to be seen in neurology practices.

Methods: Relevant literature was systematically reviewed and strength of evidence classified based on the American Academy of Neurology's criteria (Level A: established; Level B: probable; Level C: possible).

Results: An increased risk of falls is established among persons with diagnoses of stroke, dementia, and disorders of gait and balance (Level A) and probable among patients with Parkinson disease, peripheral neuropathy, lower extremity weakness or sensory loss, and substantial vision loss (Level B). A history of falling in the past year strongly predicts the likelihood of future falls (Level A). Screening measures have been developed to further assess risks of falls, including functional assessments that may be useful (Levels B and C). Several of these assess overlapping neurologic functions—i.e., gait, mobility, and balance—and there is insufficient evidence to assess whether they offer benefit beyond that provided by a standard neurologic examination.

Conclusions: Patients with neurologic or general conditions associated with an increased risk of falling should be asked about recent falls and further examined for the presence of specific neurologic deficits that predict falls, which include gait and balance disorders; deficits of lower extremity strength, sensation, and coordination; and cognitive impairments. If substantial risks of falls are identified, appropriate interventions that are described in other evidence-based guidelines may be considered. *Neurology*® 2008;70:473–479

Each year, unintentional falls in the United States account for more than 16,000 deaths, of which three quarters occur among persons over 64 years of age.[1] As a result of falls, seniors experience nonfatal injuries resulting in nearly 500,000 hospitalizations and more than 1.8 million emergency department visits annually.[1,2] In addition to advanced age, several specific risk factors have been identified, including muscle weakness, deficits in gait or balance, visual deficits, arthritis, impairments in activities of daily living, depression, and cognitive impairment.[3] Use of medications—especially sedatives, antidepressants, and neuroleptics—is an additional risk factor.[4,5] There is evidence that multiple risk factors in a single patient have additive effects.[3,6] The risk factors described are relevant to many of the patients seen in neurology practices.

Evidence-based guidelines for interventions that can reduce the risk of falls in older persons have been published in the last several years.[7,8] According to these guidelines, interventions with demonstrated efficacy in older, community-dwelling populations include gait training (including use of assistive devices), review and reduction of medications (especially psychotropics), and exercise programs with balance training. Interventions with demonstrated effi-

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cacy in older populations receiving long-term care include comprehensive assessments, staff education, use of and training in assistive devices, and reduction of medications. These guidelines, however, do not fully address the increased risk of falls in persons with chronic neurologic conditions, nor do they fully evaluate the effectiveness of methods to screen for those most at risk.

Because many patients at risk of falling seek neurologic consultations, neurologists have opportunities to identify those at greatest risk, document risk factors, and offer interventions that may prevent falls among patients with chronic neurologic disease (figure). To this end, we attempt to answer these questions: Which neurologic conditions are associated with an increased risk of falling? Are there practical clinical screening methods for neurologists that can accurately identify older patients and those with chronic neurologic conditions who are at high risk of falling?

DESCRIPTION OF THE ANALYTICAL PROCESS

Types of falls considered in this review. Falls are generally defined as sudden, unintentional, and unexpected events that result in a person's coming to rest on the ground or at a lower level. Usually excluded from studies of the medical risks for falls are those that result from overwhelming environmental hazards (e.g., icy walkways) or unusual activities or events (e.g., playing sports or being shoved) that would place any person at high risk. While falls frequently follow loss of consciousness due to seizures or syncope, managing the risk of falling due to these conditions is distinct from that for most other falls and is usually considered in separate publications. We have limited our review to studies that address falls occurring without prior loss of consciousness and to studies where falls are analyzed as a principal outcome, rather than fall-related injuries.

Search strategy. We searched the National Library of Medicine MEDLINE database for articles indexed under the search term (medical subject heading) "accidental falls" (or its subcategories) and under either 1) at least one of the terms "screening" or "functional testing" or "clinical evaluation," or 2) "nervous system diseases" (or its subcategories, which include specific diagnoses) and "epidemiologic methods" (or its subcategories). The search was limited to English-language articles published between January 1980 and January 2005. Key articles were also identified from comprehensive recent reviews of risk factors for falls found from this search and a search of the Cochrane Library.

Of the 193 potentially relevant citations retrieved by this search, 86 articles met our criteria for relevance: 1) they measured non-syncopal falls as an outcome, and 2) they addressed specific neurologic risk factors or screening tools that could be easily applied in a clinical setting without special equipment. The majority of articles described the experience of seniors living in the community. Most commonly, the articles described prospective cohort studies of incident falls; exceptions (i.e., retrospective cohort or case-control studies) are noted in table e-1 on the *Neurology*® Web site at www.neurology.org. These reports were analyzed in full by at least two of the authors and rated according to the AAN criteria for determining quality of evidence relating to prognosis or prediction of outcomes (appendix e-2). A few articles received discordant ratings, resolved by consensus after discussions between the reviewers. Information pertaining to 1) the nature of the risk factor and measurement of risk or 2) the screening test, its intended use, and its sensitivity, specificity, and predictive value, was extracted for articles rated as Class III or higher. Where at least two Class III—or one or more Class I or II—articles pertaining to a single risk factor or screening test were found, these were included in this practice parameter and in the evidence table available online (table e-1). Conclusions and recommendations were made according to the AAN criteria (appendix e-3) for translating the quality of prognostic evidence to recommendations. Because of space limitations, evidence supporting Level C recommendations was described only in appendix e-4.

ANALYSIS OF EVIDENCE

Risk of falls determined from history of falls. Many follow-up studies we reviewed identified a previous history of falls among their participants, enabling calculations of the risk of falls and an analysis of the sensitivity and specificity of this predictor. Most commonly, the period described for the history of falls was 1 year (range: 3 months to 2 years). Some studies distinguished reports of single and multiple earlier falls, with higher risks of future falls associated with the latter.

Five Class I studies examined the risk of future falls among older adults with a history of recent falls. These found relative risks (RRs) of 2.4 (95% CI 1.9 to 2.9),[9] 2.6 (no CI given),[10] and 2.5 (1.9 to 3.4)[6] and ORs of 3.7 (1.3 to 10.0)[11] and 2.4 (1.3 to 4.4).[12] Among 10 Class II studies, ORs were 3.0

(1.3 to 7.3),[13] 16.0 (4.4 to 58.0),[14] 5.0 (1.2 to 20.9),[15] 2.0 (1.2 to 3.5),[16] 3.5 (1.2 to 9.6),[17] 2.4 (1.3 to 4.4),[12] 5.4 (1.8 to 15.7),[18] 3.1 (2.2 to 4.4),[19] 12.5 (3.0 to 52.2),[20] and 4.0 (1.3 to 12.1).[21] Other Class II follow-up studies reported RRs of 1.9 (1.3 to 2.9) and 1.8 (1.3 to 2.4),[22] and 2.0 (1.3 to 3.1).[23] Class III studies yielded ORs of 4.2 (1.6 to 10.5)[24] and 9.0 (4.3 to 19.1),[25] and an RR of 1.8 (1.5 to 2.2).[26]

One Class II study reports that a history of falls has a sensitivity of 0.86 and specificity 0.86 as a predictor of future falls.[13] These measures can be calculated from the data in six other prospective Class I and II studies, which yield a range of sensitivity from 37% to 76% and a range of specificity from 63% to 91%.[6,9,16,18,20,24] Pooled data from these six studies yield a combined sensitivity of 50% and specificity of 80%, with an RR of 2.4 (95% CI 2.1 to 2.8) and an OR of 4.2 (3.3 to 5.3). Given a history of falls, the pooled absolute risk of falling during follow-up was 55%.

Risk of falls due to neurologic conditions determined from history and examination. Most studies of the risk of falls have focused on older populations and enrolled modest numbers of participants. Accordingly, available data address these risks only for relatively common neurologic conditions, especially those affecting predominantly older populations. Diagnoses for which an increased risk of falling has been documented include stroke, Parkinson disease, dementia, and peripheral neuropathy. Impairments of neurologic function that carry an increased risk of falling, irrespective of diagnosis, include disorders of balance, disorders of gait, lower extremity weakness or sensory loss, and loss of vision.

Stroke. Three Class I studies found significantly greater risk of falling among persons with a past history of stroke, yielding RRs of 1.9 (95% CI 1.5 to 2.5),[9] 2.3 (1.2 to 4.3),[27] and 2.4 (1.3 to 4.5).[10] Another Class I study yielded an insignificant RR of 1.7 (0.8 to 3.4).[28] With a history of stroke, the absolute risk of falling during follow-up was 34%, using data pooled from three of these studies.[9,27,28] One Class III study demonstrated that patients with stroke have an increased risk of falls among persons undergoing rehabilitation, with an OR of 4.0 (2.5 to 6.5).[29] For predicting risk of falls among hospital patients with stroke receiving acute care or rehabilitation, one Class III study identified cognitive impairment (RR 1.9, CI 1.2 to 3.1) and confusion (RR 1.5, CI 1.0 to 2.3),[30] and another Class III study identified impairment in activities of daily living (OR 2.9, CI 1.4 to 6.0).[31]

Parkinson disease. One Class I study estimated an increased risk of falls (OR 9.5, CI 1.8 to 50.1) among seniors with Parkinson disease[12]; this association was supported by two Class III studies yielding an OR of 2.5 (1.5 to 4.1)[32] and a RR of 2.2 (1.5 to 3.1).[26] One Class II study reported the absolute risk of falls among persons with this condition as 68% during the follow-up period.[21] When the occurrence of falls was compared among persons with more severe Parkinson disease and unaffected controls, an OR $>$ 100 (3.1 to 585) was obtained (Class II)[15]; when those with more severe Parkinson disease were compared with those less severely affected, an RR of 1.8 (1.1 to 2.9) was found (Class II).[33] Other Class II or III studies of persons with Parkinson disease revealed that those with postural instability were at much greater risk of falls than those without instability (OR 8.9, CI 3.1 to 26.1),[34] and those with absent arm swinging during walking were also at greater risk (OR 4.3, CI 1.3 to 13.7).[21]

Dementias and cognitive impairment. Among 12 studies of fall risk in persons with dementia or cognitive impairment, definitions of these conditions varied. Most commonly, diagnoses were based on findings from the standardized Mini-Mental State Examination,[35] or criteria of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, 3rd edition, revised*[36] (table e-1). Two Class I studies of community-dwelling seniors found an increased risk of falls among those with cognitive impairment, yielding an RR of 2.3 (1.5 to 3.5)[6] and an OR of 6.4 (2.9 to 13.2).[11] Six Class II studies, representing both community-dwelling and institutionalized older populations, indicated increased risks of falls in the presence of dementia (ORs of 4.8, CI 1.7 to 13.6[37]; 1.9, CI 1.2 to 2.9[38]; and 6.7, CI 1.1 to 42.5[21]) or cognitive impairment (ORs of 15.2, CI 1.5 to 149.3[39] and 1.4, CI 1.1 to 1.8[40] and an RR of 5.0, CI 1.5 to 16.6[41]). One Class II study found a higher risk of falls among moderately demented persons than in those who were mildly demented (OR 2.5, CI 1.0 to 6.2).[42] Four Class III studies also provide evidence that dementia or cognitive impairment increases the risk of falling among institutionalized seniors, yielding ORs of 1.9 (1.2 to 3.1)[25] and 2.0 (1.0 to 4.0)[43] and an RR of 1.7 (1.3 to 2.3).[26] An analysis of pooled data from five of these studies indicates an absolute risk of falling of 47% among patients with dementia during study follow-up.[6,37,40,42,43]

Peripheral neuropathy. One Class I study[28] yielded an RR of 3.9 (2.1 to 7.0) with an absolute risk of falling of 55% during an average follow-up time of nearly 6 months. Two Class III studies[44,45] also

found an increased risk of falls among persons with peripheral neuropathy, yielding ORs of 6.3 (1.4 to >100)[44] and 17 (2.5 to 100).[45]

Disorders of gait and balance. Ten studies associated various signs or symptoms of gait or balance abnormalities with increased risks of falling. The definitions of such abnormalities varied among studies in substance and amount of detail (table e-1). Some addressed abilities to perform standing tasks (e.g., feet together or semi-tandem, response to limited push); most addressed the evenness, steadiness, or pace of normal walking; and some included special walking tasks (e.g., varying pace, turning, or tandem gait). The populations studied included older adults residing in a variety of settings—communities, housing for seniors, or nursing homes—depending on the study. Only three studies focused on specific neurologic diagnoses, i.e., stroke[17,46] or Parkinson disease.[34]

In two Class I studies, one reported an OR of 2.7 (1.1 to 6.2)[12] and the other reported RRs between 1.7 (1.1 to 2.7) and 2.5 (1.7 to 3.8), depending on the number of abnormalities observed.[6] Four Class II studies yielded ORs of 3.3 and 7.0,[39] 6.0 (1.7 to 21.6),[17] 8.1 (2.0 to 32.8),[47] and 1.9 (1.4 to 2.7),[40] and an RR of (1.4 to 4.5).[23] Two Class III studies yielded an OR of 2.8 (2.0 to 3.9)[32] and an RR of 1.4 (1.2 to 1.7).[26] For self-reported difficulties with balance or walking, two Class II studies found ORs of 3.0 (1.7 to 5.0)[48] and 6.2 (1.8 to 21.5).[17]

Lower extremity weakness or sensory loss. Among studies, the criteria for determining lower extremity weakness or sensory loss also varied. One Class I study reported an RR for falls of 2.4 (1.7 to 3.2) among seniors with lower extremity disability manifest by "problems with strength, sensation, or balance."[6] A Class II study reported ORs of 2.2 (1.1 to 4.7) among stroke survivors with lower extremity motor impairment and 3.1 (1.5 to 6.8) among those with combined lower extremity motor and sensory impairments.[46] One Class III study reported an OR of 1.8 (1.1 to 3.2) for seniors with lower extremity sensory loss and an OR of 4.1 (2.2 to 7.4) for those with hip flexion weakness.[49]

Use of assistive devices. One Class I study reported an RR for falls of 2.5 (1.4 to 4.4) among seniors who used a walker or cane.[28] Two Class III studies reported sensitivities of 59% and 23% with specificities of 76% and 100% for this criterion.[50,51]

Vision loss. One Class I study reported an RR for falls of 1.7 (1.2 to 2.3) among seniors with vision loss (≥20% diminished near acuity measured by Jaeger's test type),[6] and a Class I study found an increased risk of falls among seniors with impaired near contrast sensitivity, with a hazard ratio of 1.7.[52]

Among Class III studies, for persons with corrected visual acuity less than 20/30, one indicated an RR for falling of 2.1 (C.I. 1.3 to 3.4),[53] while another, using a corrected visual acuity of 20/60 as the cutoff value, found a sensitivity of 76% and specificity of 57%.[54] A third Class III study reported an OR of 1.8 (1.5 to 2.1) for the risk of falling among seniors with impaired vision.[55] Other Class III studies yielded ORs of 2.9 (1.8 to 4.7) for adults with nuclear cataracts[56] and 3.2 (1.5 to 6.8) for seniors who were blind.[57] For self-reported impaired eyesight, a Class II study found an OR of 2.6 (1.7 to 4.1).[48]

Risk of falling determined from other screening assessments of mobility, gait, and balance. ***Get-Up-and-Go test and Timed Up-and-Go Test.*** The Get-Up-and-Go test and the Timed Up-and-Go Test are closely related measures of ability to rise independently from a sitting position, walk a short distance, turn around, then walk back and sit down (appendix e-5). Two Class II[58,59] and three Class III studies[60-62] suggested these measures were useful in assessing risk of falling. A Class II evaluation of the predictive qualities of the Timed Up-and-Go Test among community-dwelling seniors found that this screening test had a sensitivity of 77% and, overall, correctly classified 93% of participants.[58] Among patients on an inpatient rehabilitation unit, in contrast, the sensitivity of the Get-Up-and-Go test was 91%, but its specificity was only 22%.[59] A Class III evaluation of the timed up and go test among seniors yielded a sensitivity of 89% and specificity of 87%.[61]

Standing unassisted from sitting position. The "standing unassisted" test simply measures people's ability to rise from sitting in a chair without using their arms. One Class I study[9] suggested limited utility for this measure alone (i.e., failing the test), which yielded a sensitivity of just 0.31, but a specificity of 0.90, while one Class II study[17] reported an adjusted OR for falling of 3.3 (1.0 to 10.8) for those who failed. Another Class I study timed the performance of this test, finding that the OR for falls among persons either unable to stand or requiring 2 seconds or more to do so was 3.0 (1.2 to 7.2).[12]

Tinetti Mobility Scale. The Tinetti Mobility Scale is a measure of dynamic stability while carrying out 14 tasks (appendix e-1). Four Class

II studies yielded sensitivities of 96%, 76%, 93%, and 62% and specificities of 96%, 83%, 11%, and 70% for various cutoff scores.[18,20,58,63] The versions of this scale that were used varied slightly among these studies.

CONCLUSIONS

- An increased risk of falls is established among persons with diagnoses of stroke, dementia, disorders of gait and balance, and those who use assistive devices to ambulate (Level A).
- An increased risk of falls is also probable among patients with Parkinson disease, peripheral neuropathy, lower extremity weakness or sensory loss, and substantial loss of vision (Level B).
- Other systematic, evidence-based reviews (not rated) of numerous studies have identified general risk factors for falls, including advanced age, age-associated frailty, arthritis, impairments in activities of daily living, depression, and the use of psychoactive medications including sedatives, antidepressants, and neuroleptics.[3-5,7]
- As for screening measures that may predict or further assess fall risk, a history of recent falls is an established predictor of future falls (Level A).
- Additional screening instruments of probable value include the Get-Up-And-Go Test or Timed Up-and-Go Test, an assessment of ability to stand from a sitting position, and the Tinetti Mobility Scale (Level B). Other screening instruments of possible utility are described in appendix e-4 (Level C).
- Some of these measures assess similar or overlapping neurologic functions—i.e., gait, mobility, and balance—and there is insufficient evidence to assess whether such measures offer benefits beyond that offered by a standard comprehensive neurologic examination.

RECOMMENDATIONS

- All of the patients with any of the fall risk factors described above should be asked about falls during the past year (Level A).
- After a comprehensive standard neurologic examination, including an evaluation of cognition and vision, if further assessment of the extent of fall risk is needed, other screening measures to be considered include the Get-Up-And-Go Test or Timed Up-and-Go Test, an assessment of ability to stand unassisted from a sitting position, and the Tinetti Mobility Scale (Level B).
- Other screening measures of possible utility described in appendix e-4 may be considered (Level C).

Clinical context. Interventions to reduce identified fall risks are beyond the scope of this parameter. However, other evidence-based guidelines for the management of these risks have been developed that may be consulted,[7,8,64] as well as guidelines for the treatment of underlying disorders where possible.

RECOMMENDATIONS FOR FUTURE RESEARCH Additional prospective studies are needed to assess predictors of fall risk among a broader spectrum of patients as well as to further assess the risk for persons with specific neurologic conditions that may affect gait, mobility, or balance. Analyses should include evaluations of the inter-rater reliability of predictors, comparative risk, sensitivity, and specificity. In particular, these studies should:

- Systematically assess predictive characteristics of individual and combined elements of a standard neurologic examination
- Compare the relative utility of the gait, mobility, and balance tests reviewed above
- Emphasize practical screening tools that may be performed quickly and easily in the office or at the bedside.

DISCLAIMER This statement is provided as an educational service of the American Academy of Neurology. It is based on an assessment of current scientific and clinical information. It is not intended to include all possible proper methods of care for a particular neurologic problem or all legitimate criteria for choosing to use a specific procedure. Neither is it intended to exclude any reasonable alternative methodologies. The AAN recognizes that specific patient care decisions are the prerogative of the patient and the physician caring for the patient, based on all of the circumstances involved. The clinical context section is made available in order to place the evidence-based guildeline(s) into perspective with current practice habits and challenges. No formal practice recommendations should be inferred.

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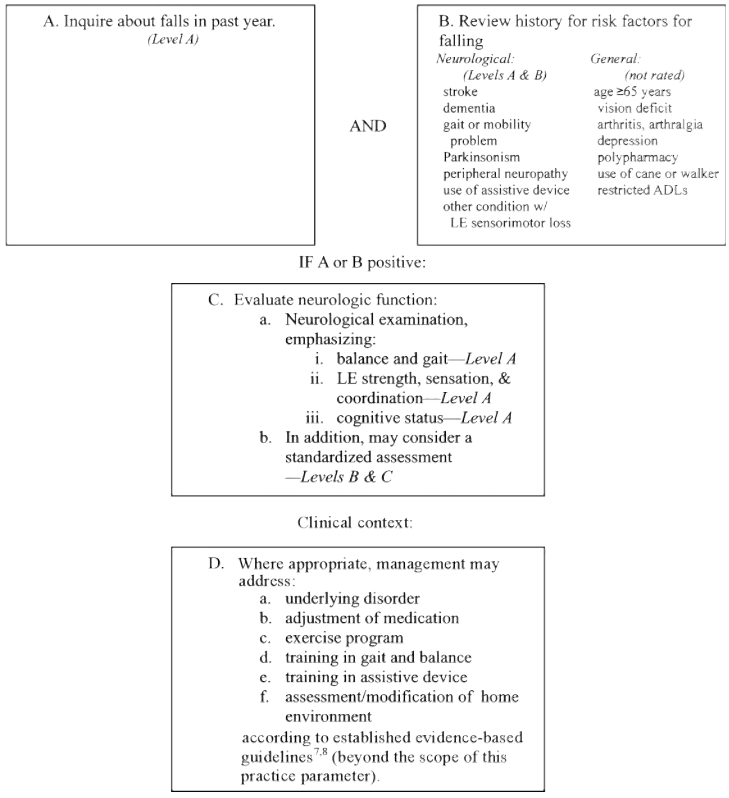
Figure Suggested key elements for assessing risk of falls and managing patients at risk



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