6.8 Falls, faints, and fragility fractures 579

6.8 Falls, faints, and fragility fractures 579

ESSENTIALS Falls and their complications are the fifth leading cause of deaths in older adults. They typically result from the interplay of the envir- onment, comorbidity, and age-related changes in postural stability. Recurrent falls can be debilitating in terms of physical consequences and in terms of the psychological impact of fear of falling, resulting in restriction of activity leading to a spiral of deconditioning, further loss of function, low mood, depression, and social isolation. Since some falls can be prevented, all older people in contact with healthcare professionals should be asked routinely whether they have fallen in the past year. Patients reporting single falls should undergo gait and balance assessments to identify those with higher risk who may benefit from a multifactorial falls risk assessment, which is required by those reporting two or more falls, or difficulties with gait and balance, and by any older patient who seeks medical attention as the result of a fall. Management requires a multifactorial approach, directed by the relevant contributors determined in the assessment process. The aim should be to prevent future falls and minimize their consequences, while avoiding imposing restrictions to the point that they negatively impact function, independence, and quality of life. The incidence of syncope is 11 events per 1000 person years over the age of 70 years, and is a differential diagnosis in older adults with unexplained falls. Orthostatic hypotension is a common cause in older people, treatment of which includes elimination of contrib- uting medications when possible, increased salt intake, increased fluid intake, and advice to rise slowly from a seated or lying position. Fragility fractures occur as the result of low energy mechanical forces that under usual circumstances would not result in a fracture, and all patients at risk of falls should undergo a bone health assess- ment and determination of their future risk of major fracture, with treatment of osteoporosis when appropriate. Introduction A fall is defined as ‘an unexpected event in which the participants come to rest on the ground, floor, or lower level’. Falls are common in older adults with one in three adults over the age of 65 years sustaining at least one fall per year, increasing to one in two for the over 80s. The incidence is similar in men and women, but women are more likely to sustain an injury. Falls have significant conse- quences with 2–5% resulting in fractures, up to 10% serious injury and hospitalization, along with loss of confidence, functional in- dependence, and an associated increased likelihood of a move to institutional care. Falls and their complications are the

leading cause of death from injury in adults over 65 years and the fifth leading cause of all deaths in older adults. They also have a considerable economic cost accounting for an estimated £2 billion of healthcare spend in the United Kingdom annually, and $34 billion in the United States in 2013. This chapter will examine the risk factors for falls in older adults and the role of comprehensive assessment and multifactorial interventions to reduce the risk of future falls. This will include evaluation and treatment of orthostatic hypotension and carotid sinus syndrome and their relationship to falls in older adults. The association between falls and fragility fractures will be considered and controversies relating to calcium and vitamin D supplemen- tation and the use of anticoagulants in those at high risk of falling will be discussed. Consequences of falls The consequences of falls range from none or minor injuries to severe such as hip fracture, head trauma, and death due to the in- juries sustained. Recurrent falls can be debilitating both in terms of physical consequences but equally in terms of the psycho- logical impact of fear of falling, resulting in moderate restriction of activity in up to two-thirds of those affected. Fear of falling following a hip fracture is associated with an increased risk of institutionalization and mortality. Only half of older people who fall can get up unaided, frequently leading to prolonged periods on the ground or a ‘long lie’, which in turn can result in develop- ment of pressure ulcer, rhabodomyolyis, and renal failure, hypo- static pneumonia, and additional loss of function. Older patients will frequently limit their mobility and activity in an effort to minimize their risk of falls, which can result in them dropping 6.8 Falls, faints, and fragility fractures Fiona Kearney and Tahir Masud

580 Section 6 Old age medicine outside activities, hobbies, and social outlets, leading to a spiral of deconditioning, further loss of function, low mood, depression, and social isolation. Risk factors Falls in older adults are rarely due to a single cause (Table 6.8.1). Most result from the interplay of the environment, comorbidity, and age-related changes in postural stability. A history of previous falls, particularly two or more falls in the preceding year, is the most powerful predictor of future falls. Other risk factors can be divided into intrinsic and extrinsic. Intrinsic factors include age, gender, disability, and comorbidity. Extrinsic risk factors largely relate to the domestic and outdoor environments, medications, and mobility aids. The risk of falling increases as the number of risk factors increases. The contribution of individual risk factors varies ac- cording to the population and setting, highlighting the multi- factorial nature of causation. In a systematic review, gait and balance impairments and medications are the most consistent risk factors for falls. Intrinsic risk factors Co-morbidity An increased incidence of falls has been described in a var- iety of chronic medical conditions including, but not limited to, Parkinson’s disease (PD), stroke, osteoarthritis, ischaemic heart disease, heart failure, chronic obstructive pulmonary disease, de- pression, osteoporosis, and diabetes. The nature of the association is often unclear, but likely reflects the added burden of chronic dis- ease and treatments on the homeostatic mechanisms maintaining postural stability. The risk for falls increases with increasing number of chronic conditions. Cardiac arrhythmias, impaired autoregulation of blood pressure, or hypotension secondary to antihypertensive medications can lead to transient cerebral hypoperfusion and falls. Orthostatic hypotension and syncope are considered in more detail later. Parkinson’s disease has a multifactorial association with falls through the abnormal walking pattern associated with bradykinesia, rigidity, and the characteristic shuffling gait, but also as a consequence of the increased incidence of orthostatic hypotension due to the disease and treatment. There is also a tem- poral relationship between Parkinson’s disease and falls medi- ated by cognitive impairment and executive dysfunction. Patients with stroke have an impaired reaction to loss of balance, in

add- ition to motor impairments and the need for mobility aids fol- lowing a stroke. Osteoarthritis is associated with joint deformity and pain that impairs mobility and a person's ability to negotiate obstacles. Peripheral neuropathy is associated with impaired balance and stability partially explaining the increased risk of falls associated with diabetes. Gait and balance impairments Maintaining postural stability at rest and during the dynamic activity of walking requires the complex integration of sensory and motor information regarding the position of the body rela- tive to the surroundings and the ability to generate forces to control body movement, particularly during times of challenge. Integration of the sensory and motor system occurs at a higher cortical level in the brain. Deficits in any component such as peripheral sensation, proprioception, visual or vestibular func- tion, cognition, muscle coordination or strength can result in increased postural sway and poor balance. Age-related changes or disorders such as cerebrovascular disease contribute to these deficits. Reduced gait speed and unstable gait are associated with falls. Automated devices now enable evaluation of a vast array of gait parameters, including cadence, step length, and stride to stride consistency. A small degree of fluctuation is present in normal adults, including healthy older adults, but there are changes in dy- namic gait responses, such as stepping over obstacles. Gait vari- ability is associated with increased falls risk and is altered in frailty and neurodegenerative diseases including Parkinson's disease and Alzheimer's disease. Gait can also be considered in broader clinical terms and clas- sified according to where in the neuromuscular network the problem is felt to arise. Using this hierarchical system, a primary gait disorder may be due to a progressive central neurological condition arising in the cerebral cortex (higher level gait dis- order), midbrain, cerebellum, or spinal cord (middle level gait disorder) or peripheral nervous system and/or the result of a musculoskeletal condition (lower level gait disorder). Common clinical causes and the associated gait features are outlined in Table 6.8.2. Muscle weakness Lower limb muscle weakness of knee extension and ankle dorsifexion in particular is associated with falls. It may arise as a consequence of age-related changes or wasting of muscle groups due to associated osteoarthritis. Clinically this may present with difficulty standing from a seated position. Table 6.8.1 Risk factors for falls in older adults Intrinsic Extrinsic Female gender Advancing age Co-morbid conditions • Cardiovascular disease including orthostatic hypotension and syncope • Parkinson's disease • Stroke • Sensory impairments/peripheral neuropathy • Osteoarthritis/rheumatoid arthritis Gait and balance impairment Muscle weakness/myelopathy Cognitive impairment/impaired executive function Visual impairment Psychological factors • Depression • Fear of falling Nutritional deficiencies Home trip hazards Bifocal lenses Medications/ Polypharmacy Alcohol Mobility aids Inappropriate footwear Institutional care

 Cognitive impairment Cognitive impairment at least doubles falls risk. There is a height- ened association in those with poor executive function or decision- making skills, because gait is not in fact an automatic motor activity but is a learned complex motor task requiring attention. As an individual's cognitive capacity declines so too does their cap- acity to adequately allocate attention to walking. Reduced capacity for attention results in an increased risk of falls. This is exemplified by the 'stops walking when talking' phenomenon, first reported in 1997, where an individual stops walking when engaged in a sec- ondary attention demanding activity, indicating impaired cap- acity to dual-task. In fact dual-task impairment is associated with a fivefold increased risk of falls. Dual-task impairment is thought to clinically represent the inability to appropriately divide attention between two cognitively demanding tasks, and failure to prioritize upright posture or walking when distracted, leading to increased postural

sway and gait variability, in turn leading to falls. Executive function also relates to decision-making, planning, and judgement, and if impaired, may lead to an individual making unsafe decisions about mobilization such as not waiting for as- sistance due to lack of insight into deficits, forgetting to use mo- bility aids or using them unsafely, or failing to adapt to challenges posed by obstacles, low lighting, or changes in surface. Also, it is interesting to note that declines in gait speed and stability have pre- dicted cognitive decline in older adults. The association may reflect a shared anatomical substrate rather than a causative relationship. Visual impairment Falls are associated with a spectrum of visual impairment. As well as reduced visual acuity, visual field defects, impaired depth perception, and contrast sensitivity are implicated. The common conditions of cataract, macular degeneration, and glaucoma pro- duce one or more of these deficits. Bifocal and varifocal lenses used to compensate for visual acuity impairments are also associated with falls due to their impact on depth perception and contrast sensitivity for obstacles. Cataracts are associated with an increased risk of falls, borne out by the reduction in rate of falls following ex- pedited first cataract surgery. Psychological factors Depression is associated with altered gait dynamics and an in- creased risk of falls. Impaired executive function is thought to me- diate, in part, this relationship between depression and falls. Up to 70% of recent fallers and 40% of people who have not fallen re- port fear of falling. Fear of falling is associated with poorer physical performance, slower gait, and reduced muscle strength, likely due in part to the self-imposed restriction to activity and function by those with fear of falling. Fear of falling predicts falls at one year making it both a risk factor for and a consequence of falls. Nutritional deficiencies Poor nutrition, evidenced by a low body mass index and reduced muscle mass is associated with falls. Vitamin D deficiency is asso- ciated with muscle weakness and increased postural sway. Extrinsic risk factors Medications and falls Polypharmacy (≥4 drugs) is an independent risk factor for falls. Increasing numbers of medications in addition to recent dose changes are associated with falls, but so too is poor medication Table 6.8.2 Neuromuscular classification of gait disorder Level at which gait abnormality arises Associated conditions Gait features Higher level Cerebrovascular disease and dementia Apraxic gait Difficulty initiating walking Small shuffling steps (‘marche a petit pas’) Occasional freezing and difficulty turning Lacks other typical features of Parkinsonism (tremor and rigidity) Stroke Hemiplegic with circumduction of the hip on affected side Normal pressure hydrocephalus Broad-based gait Middle level Cerebellar Disease Broad-based gait Cerebellar ataxia Parkinson’s disease (dopamine deficiency in
basal ganglia) Parkinsonism (cerebrovascular disease or medications) Shuffling festinant gait Small steps Stooped posture Difficulty turning Freezing Spinal cord lesions Multiple sclerosis Paraplegic gait/Scissoring gait Lower level Peripheral neuropathy Distal weakness Poor dorsiflexion Foot drop Occasionally broad-based with sensory ataxia and positive Romberg’s test Osteoarthritis Antalgic/limping gait Myopathy Difficulty climbing stairs or rising from a seated position Myopathic/waddling gait

582 Section 6 Old age medicine compliance. In particular, drugs affecting the central nervous system and drugs moderating blood pressure or heart rate are most frequently implicated in falls. Antipsychotic medications (odds ratio (OR) of falls 1.6), benzodiazepines (OR 1.6), and antidepressants (OR 1.7) including newer selective serotonin reuptake inhibitors, are the most common drugs associated with falls. People taking two or more psychotropic medications are at an even greater risk of falls. Antihypertensive medications are associated with a 20% increased risk of falls, with stronger associations for vasodilator medications and weaker associations for diuretics and β-blockers. Alcohol An increased risk of falls is associated with excessive alcohol intake but not

with alcohol consumption within the recommended limits. Environmental The evidence for environmental factors as an independent pre- dictor of falls is mixed. Hazards such as loose carpets, slippery floors, ill-fitting footwear, poor lighting, and unsuitable mobility aids are likely most relevant for an individual with relevant in- trinsic risks such as poor sight, balance, or cognition. Institution dwellers Being resident in a care home or similar facility is associated with a threefold increased risk of falls compared to a community-dwelling older population. Fall rates may be even higher among mobile care home residents as rates decrease among very frail bed-bound residents unable to rise from a chair unaided. The prevalence of dementia and long-tem conditions in this group will account for some of the associated increased risk of falls. Presentation Individuals will typically describe the immediate nature of a fall at presentation (trip, slip, 'legs gave way', and so on) or present with an injury as the consequence of a fall. Up to 80% of falls that do not result in injury are not reported. This may be due to poor recall and cog- nitive impairment, unwillingness by the individual to be considered frail, or the misconception that falling is a normal part of ageing. Since some falls can be prevented, all older people in contact with healthcare professionals should be asked routinely whether they have fallen in the past year and asked about the frequency, context, and characteristics of the fall(s). Patients reporting single falls should undergo gait and balance assessments to identify those with higher risk who may benefit from a multifactorial falls risk assessment. Patients reporting two or more falls, those who re- port difficulties with gait and balance, and any older patient who seeks medical attention as the result of a fall, are also regarded as at higher risk and require further assessment. Multifactorial assessment History Assessment begins with a comprehensive history eliciting the fre- quency of falls, the circumstances in which the fall(s) occurred, prodromal symptoms, and injuries sustained. Injurious falls are more often associated with loss of consciousness and may point to an underlying cardiac aetiology or diagnosis of syncope. Patients with observed syncope may deny loss of consciousness, but will be generally unable to adequately describe the fall itself. A collateral history should be obtained if available, as up to one-third of older adults without cognitive impairment will not recall the events surrounding a fall three months later. A comprehensive review of past medical history and comorbidities may reveal the cause of, or potential contributors to, the fall. Diagnoses and their association with falls are out- lined in Table 6.8.3. Medication review A detailed review of medication and their potential contribution to falls should be completed. Table 6.8.4 lists the common medi- cations associated with falls and the proposed mechanism through which they increase this risk. Physical examination Physical assessment encompassing all major systems is focussed on determining previously undiagnosed problems in addition to evaluating the severity of existing comorbidity and extent to which Table 6.8.3 Clinical diagnoses and their association with falls System Condition Association with falls Neurological Stroke Gait/balance/mobility Muscle strength Visual field defects Central processing/cognitive impairment Parkinson's disease Gait/mobility Orthostatic hypotension Cognition/executive dysfunction at later stages Multiple sclerosis Gait/mobility Dementia Impaired decision-making Gait abnormalities Vision Cataracts Glaucoma Macular degeneration Visual impairment Bifocal lenses Impaired depth perception Vestibular disorders Labyrinthitis Meniere's disease Balance impairment Dizziness Cardiovascular Syncope Loss of consciousness Orthostatic hypotension Dizziness Loss of consciousness Ischaemic heart disease Arrhythmias Medications Endocrine Diabetes mellitus Sensory neuropathy Visual impairment Hypothyroidism Muscle weakness Musculoskeletal Osteoarthritis Joint pain and deformity Rheumatoid arthritis Joint pain and deformity Urinary Urinary frequency/ urgency Rushing to the toilet Nocturia Vitamin deficiencies Vitamin B12 deficiency Impaired proprioception Vitamin D deficiency Impaired muscle strength Increased postural sway

6.8 Falls, faints, and fragility fractures 583 it is contributing to falls. Neurological examination should test the central and peripheral nervous system in addition to the cerebellum. An examination of the extremities should assess muscle bulk and function, joint deformities, and sensory neuropathies. Asking a patient to walk will reveal information not only about strength, balance, and muscle function, but also about gait patterns associated with certain conditions outlined in the earlier sections. Nystagmus, if present, should be differentiated as to whether it is likely arising from a central (cerebellar) or peripheral (vestibular) problem. Tests of visual acuity (e.g. Snellen Chart) and an eye examination to ascertain the presence or absence of cataracts should be com- pleted. Some specialized clinical-based assessments include con- trast sensitivity. Cardiovascular examination should assess heart rate and regu- larity of rhythm, and establish the presence or absence of murmurs that may be associated with syncope, such as severe aortic sten- osis. Lying and standing blood pressures consistent with standard testing protocols (Box 6.8.1) should be completed. Orthostatic hypotension is defined as a symptomatic systolic blood pressure (BP) drop of 20 mm Hg (or to below 100 mm Hg) or a diastolic BP drop of 10 mm Hg within three minutes of standing. A standard test of cognition should be incorporated into falls assessment to assess the degree of cognitive deficit (if there is estab- lished cognitive impairment) and also to identity cognitive impair- ment not recognized prior to the presentation with a fall. Review of footwear, walking aids, and—for higher-risk individuals—the home environment, should also be completed. Several questionnaire type tools are available and used by occu- pational therapists to assess the likely role of home hazards, which may help target limited home visiting capacity on those most likely to benefit. There is evidence that falls can be prevented using a hazard checklist combined with observation in the home environ- ment, specifically by an occupational therapist, to understand and modify the fall risks associated with performance of activities of daily living (ADL). Functional assessment Several functional assessments aim to establish falls risk. While this exemplifies the importance of reliably ascertaining falls risk, it also serves to highlight that there is no single optimal test for this purpose. The Timed Up and Go Test (TUG) is a simple test of strength and mobility that constitutes the time taken for a patient to stand from a seated position without using their arms, walk 3 metres, turn around, and return to the seated position. Reference ranges for average performances within age groups have been established, but definitive cut-offs have been difficult to define in terms of asso- ciated risk of falls, hence its value lies in its simplicity to perform and as a prompt to additional assessment when very abnormal. Additional specialized assessments are detailed in Table 6.8.5. Most of these require specialist training, with some of them taking up to 45 minutes to complete, limiting their utility outside of a dedicated falls clinic. Investigations Routine blood investigations may identify the possible contribu- tion of intercurrent illness such as infection to the presentation. More chronic issues such as electrolyte disturbances leading to muscle weakness, or anaemia leading to fatigue and dizziness, may also be detected. Vitamin D levels should be measured in older people who are frail, housebound, institutional residents, or members of ethnic groups with darker skin living in cooler cli- mates (e.g. South Asians in United Kingdom). Those individuals with low levels may benefit from vitamin D supplementation. Additional investigations are driven by the history or suspected underlying aetiology, such as electrocardiograms (ECG), echocar- diography, and 24-hour ECG monitoring if a cardiac arrhythmia or valvular lesions are implicated, or head-up tilt testing if syncope is suspected. Brain or spinal cord imaging with computed tomog- raphy or magnetic resonance imaging scanning may be indicated if pathology of the central nervous system is suspected, but not routinely. Table 6.8.4 Medications associated with falls Drug Indication Association with falls Antihypertensives Hypertension Hypotension Postural hypotension Diuretics Hypertension Heart

failure Postural hypotension Muscle weakness due to electrolyte disturbance Requiring repeated trips to the toilet or rushing to the toilet SSRIs Depression Unknown mechanism; possible postural hypotension Antiarrhythmic Atrial fibrillation Tachyarrhythmia Heart block Cardiac pause Pro-arrhythmic Benzodiazepines Anxiety Insomnia Sedation Confusion Tricyclic antidepressants Depression Pain Sedation Confusion Postural hypotension Anticholinergics Lower urinary tract symptoms Confusion α-blockers Hypertension Benign prostatic hypertrophy Postural hypotension Antipsychotics Primary psychiatric disorders Depression Behavioural and psychological symptoms of dementia Sedation Confusion Extrapyramidal side effect Sedation Impact on QT interval leading to arrhythmia Opiates Pain Sedation Confusion Box 6.8.1 Protocol for measurement of lying and standing blood pressure Lying and standing blood pressures Patients rest in the supine position for at least five minutes. Blood pres- sure is checked while supine and the patient then stands. Blood pres- sures are repeated at 1 minute, 3 minutes, and 5 minute intervals while standing using a standard sphygmomanometer.

584 Section 6 Old age medicine Investigation and management of syncope Syncope is defined as a transient loss of consciousness due to tran- sient global cerebral hypoperfusion, characterized by rapid onset, short duration and complete (spontaneous) recovery (see also Chapters 16.2.2 and 16.4). Syncope is common in older adults, with an incidence of 11 events per 1000 person years over the age of 70 years, and is a differential diagnosis in older adults with unexplained falls. Key questions in the history include information about pre cipitating factors (cough, eating, micturition), posture or position (lying, standing), activity at time of event, the presence of pro- dromal symptoms (dizziness, lightheadedness, nausea), past med- ical history (cardiac disease, arrhythmias, postural hypotension), family history of sudden death, and drug history with particular focus on medications affecting blood pressure, heart rhythm, or QT interval. An eyewitness account, if available, may give key in- formation about the events immediately before (posture change, pallor), the duration of the episode, any associated features (myo- clonic jerks), and the recovery period. Orthostatic hypotension Pathophysiology Orthostatic hypotension (OH) and carotid sinus disease subtypes of neurally mediated syncope will be considered here as they are the commoner explanations in older adults who present with a fall. Orthostatic hypotension may occur as a consequence of impaired vasoconstriction due to chronic impairment of autonomic ac- tivity. The prevalence of orthostatic hypotension is approximately 6% in community-dwelling older adults, but varies depending on the populations assessed. Impaired ability to increase sys- temic vascular resistance (SVR) in response to orthostatic stress is the most common associated pathophysiological defect. This usually reflects reduced α1-adrenegic receptor responsiveness in older adults, whereby decreased venous return and stroke volume accompanying orthostasis are not counterbalanced by an increase in systemic vascular resistance, leading to diminished cardiac output, subsequent transient cerebral hypoperfusion, and syncope. Additional mechanisms that can contribute include loss of ar- terial compliance, disturbed cerebral autoregulation, reduced plasma volume secondary to reduced plasma renin activity, and ad- renergic receptor dysfunction. Patients with orthostatic hypoten- sion may present with presyncope occurring for the same reasons but not resulting in loss of consciousness. These patients frequently use terms such as dizziness, lightheadedness, giddiness, or weak- ness to describe their symptoms. Medications are a major contributor to orthostatic hypotension in older adults. Antihypertensive medications and those affecting the cardiovascular system are most frequently implicated, but cen- trally acting medications such as phenothiazines and antidepres- sants may also have a role. Causes of orthostatic hypotension are broadly catergorized as drug-induced (antihypertensive and vasodilator

medications, diuretics, phenothaizines, antidepres- sants and Levodopa), primary autonomic failure (pure autonomic failure, Parkinson’s disease, multiple system atrophy, dementia with Lewy bodies), secondary autonomic failure (diabetes mellitus, amyloidosis, spinal cord injuries, uraemia), or volume depletion (haemorrhage or dehydration). Diagnosis and investigation In order to make diagnostic assessment of orthostatic hypoten- sion more uniform, head-up tilt testing is increasingly relied upon to confirm an initial clinic diagnosis of orthostatic hypotension. Patients undergo passive posture change on a mechanized table, from a horizontal beginning point to an upright position of ≥60 degrees. When combined with phasic blood pressure assessment using digital artery photoplethysmography, beat to beat blood pressure changes can be captured. It also allows indirect, non- invasive calculation of several cardiovascular variables, such as systemic vascular resistance, stroke volume, and cardiac output, Table 6.8.5 Gait and/or balance assessment tools Scale Description Timed Up and
Go Test • Time taken to stand from a seated position without using arms, walk 3 metres, turnaround, and return to the seated position • Reference ranges for average performance have been established in meta analyses with a mean of 8.1 seconds for 60–69 year olds, 9.2 seconds for 70–79 year olds, and 11.3 seconds for 80–99 year olds • Cut offs of 13.5–15 seconds have distinguished fallers from non fallers Physiological Profile Assessment® • Used to determine falls risk in terms of component deficits rather than the result of multiple disease entities • Assesses vision (including acuity, contrast sensitivity and depth perception), lower limb strength, proprioception, vibration sense, and muscle strength, reaction time, and body sway Tinetti Scale • Assesses 24 domains of gait and balance • Increased risk of falls in those with impairments in six or more aspects of the test Berg Balance Scale • Assesses static and dynamic balance incorporating functional assessments such as functional reach an 180 degree turns • Scored out or 56 with scores below 40 indicating an increased risk of falls Dynamic gait index • Assesses steady state walking and walking under more challenging tasks • Scored out of 24 with scores of <19 indicating increased incidence of falls Functional Reach • Requires subjects to raise their arm to shoulder height and then reach as far forward as they can without losing balance, falling forward, or taking a step. Distance of the full reach is then measured • Shorter reach with loss of balance is associated with an increased risk of falls Dual-task gait assessment • This is a proxy measure of attentional capacity and ability to divide attention where the subject completes a secondary cognitive task (naming animals or counting backwards in 3 s) while walking • Gait dynamics are compared to the reference single task condition • Impaired ability to dual task is associated with an increased risk of falls in older adults

 by means of specifically designed software that analyses the digital artery pressure waveform generated by each digital artery pulse. Administration of sublingual glyceroltrinitrate (GTN) improves the sensitivity of the test. Management of orthostatic hypotension Treatment of confirmed orthostatic hypotension includes elimin- ation of contributing medications when possible, increased salt in- take, increased fluid intake, and advice to rise slowly from a seated or lying position. World class III compression hosiery may help, but its use is often limited by the ability and dexterity of older adults to don the stockings without significant assistance. Physicians and general practitioners should be advised to treat the standing blood pressure only, and to have a low threshold for reduction of antihypertensives if orthostatic hypotension is sus- pected. Many cases will require a balance between prevention of orthostatic hypotension-related morbidity by avoiding precipitous BP drops, while managing hypertension with a view to prevention of long-term complications. Medications

that raise blood pressure can be tried if conservative management is inadequate to control symptoms. Fludrocortisone and midodrine are the drugs used most commonly in the United Kingdom. Fludrocortisone is a mineralocorticoid and acts as a plasma expander, leading to increased circulating volume and blood pressure. Although used fairly widely in the United Kingdom, the evidence base for its effectiveness is weak. Electrolytes, in par- ticular potassium, should be monitored after initiation of the drug. Midodrine is an α-agonist leading to increases in blood pressure by increasing vascular tone. At present, it is available on a named patient basis only in the United Kingdom, but more widely available throughout the rest of Europe and the United States. Its use should be considered on a case-by-case basis by a clinician experienced in its administration. Due to the mechanism of action it has the po- tential to cause hypertension, therefore it is recommended that its use should be limited to patients with resting blood pressure below 130 mm Hg systolic. It should be avoided within four hours of bed- time to minimize potential to exacerbate nocturnal hypertension. Carotid sinus syndrome Definitions and diagnosis Carotid sinus syndrome (CSS), also known as carotid sinus hyper- sensitivity is a form of reflex syncope arising from alterations in autonomic tone due to hypersensitivity of baroreceptors in the carotid reflex arc. There are three subtypes of carotid sinus syn- drome: cardio-inhibitory carotid sinus syndrome, which is defined as a ventricular pause of more than three seconds following carotid sinus massage; vasodepressor carotid sinus syndrome, which is de- fined as a drop in systolic blood pressure of more than 50 mm Hg following carotid sinus massage; and mixed carotid sinus syn- drome, which has combined features of both. Carotid sinus syndrome is provoked by carotid sinus massage in the resting horizontal position or following head-up tilt to ≥60 degrees. The carotid pulse anatomically corresponds to the carotid sinus, a concentrated area of baroreceptors. Pressure is applied in a circular motion to the left or right (never together) carotid pulse for five seconds with continuous blood pressure and electrocardio- gram monitoring to assess for a significant BP drop or sinus pause. It is repeated on the opposite side if nondiagnostic, and again on each side in the head-up tilt position until carotid sinus massage has been performed in all four potential positions, or until a clinically significant abnormality has been demonstrated. Contraindications to carotid sinus massage are stroke within three months or the presence of an unevaluated carotid bruit. The incidence of tran- sient ischaemic attack (TIA) or stroke following carotid sinus mas- sage is 1 in 1000. All patients should have a valid consent process for the procedure with discussion of relevant contraindications and complications. Management A sinus pause of more than 3 seconds following carotid sinus massage is an indication for a permanent pacemaker (PPM). The treatment of vasodepressor carotid sinus syndrome is similar to the treatment of orthostatic hypotension. In many cases, elim- ination of medications potentiating hypotension will lead to improvement or resolution of the problem. Up to one-third of older adults with the cardio-inhibitory subtype of carotid sinus syndrome will continue to fall, even after the insertion of a per- manent pacemaker. This is, in part, due to the coexistence of the cardio-inhibitory and vasodepressor subtypes of carotid sinus syndrome. Management of falls The management of falls requires a multifactorial approach, which is directed by the relevant contributors determined in the assess- ment process. The aim should be to prevent future falls and min- imize their consequences, while avoiding imposing restrictions to the point that they negatively impact function, independence, and quality of life. Co-morbid conditions should be optimized, revers- ible conditions treated, visual impairment identified (with referral for specialist input if required), contributing medications reduced or eliminated where possible, physiotherapy-prescribed strength and balance exercise training commenced, cognition monitored, and the home (or usual) environment reviewed to reduce hazards. Care plans and rehabilitation programmes

should be individu- alized and tailored to the needs of the patient and delivered by a multidisciplinary team. The minimum dose of exercise to reduce falls in older adults is 50 hours. A Cochrane review completed in 2012 summarized the evidence for falls prevention strategies and is summarized in Box 6.8.2. The role of cognitive impairment Importantly, most of the trials included in the Cochrane system- atic review excluded older participants with cognitive impairment and therefore the results may not be applicable to this group. In fact, multifactorial interventions similar to those delivered in a noncognitively impaired population have not been effective in re- ducing falls in older adults with cognitive impairment. Emerging evidence indicates that falls risk can be modified with strength and balance training in older adults with cognitive impairment, but protracted rehabilitation programmes with greater therapist input and supervision are required in comparison to a noncognitively impaired population.

586 Section 6 Old age medicine Fragility fractures Definition and consequences Fragility fractures occur as the result of low energy mechanical forces that under usual circumstances would not result in a frac- ture. This has been defined by the World Health Organization as a fall from standing height or less. Most occur in the setting of low bone mineral density (osteopenia or osteoporosis), although a third or more of some fragility fractures occur in those without osteoporosis. The commonest sites for fragility fracture are the hip (proximal femur), spine (vertebral) and wrist (distal radius), upper arm (proximal humerus), and pelvis (pubic ramus). Hip fractures have the most serious consequences in terms of both mortality and morbidity, with up to 10% dying within one month and up to a third by one year. A further third of people newly require assistance to walk one year after hip fracture. Specialist orthogeriatric liaison for optimization of care for older adults fol- lowing a hip fracture is an evidence-based standard of care, which has developed in response to the recognition of the high associated mortality due to medical comorbidity in this group. This is dis- cussed in Chapter 6.6. Assessment All patients at risk of falls should undergo a bone health assess- ment and determination of their future risk of major fracture. Assessment of bone mineral density (BMD) with dual energy X-ray absorptiometry (DXA) is the gold standard for diagnosis of osteoporosis. The National Institute for Health and Care Excellence (NICE) in the United Kingdom advise that treat- ment with a bisphosphonate following a low energy hip fracture can be considered in postmenopausal women over the age of 75 years if DXA scanning is deemed clinically inappropriate or unfeasible. Determining future risk of fragility fracture and managing ac- cordingly is central to reducing morbidity and mortality in older adults presenting with falls. There are several tools widely avail- able to estimate 10-year fracture risk based on an individual’s risk factor profile, of which the Fracture Risk Assessment Tool (FRAX, www.shef.ac.uk.FRAX) and the Q-Fracture Risk Calculator (www. qfracture.org) are most widely used. FRAX allows estimation of 10-year probability of hip fracture and major osteoporotic frac- ture using clinical risk factors alone if bone mineral density is not known. It is validated in 11 different cohorts and allows cal- culation of country-specific thresholds for cost-effectiveness of osteoporosis treatment. FRAX does not include falls risk in its modelling of fracture risk, but Q-Fracture does. Despite the es- tablished relationship between low bone mineral density and frac- ture, approximately half of hip fractures occur in women whose bone mineral density is above the threshold for osteoporosis. Assessment of clinical risk factors independent of bone mineral density is therefore important, and this includes consideration of risk of future falls. Treatments Pharmacological treatments for osteoporosis and secondary pre- vention of fragility fractures are considered in Chapter 20.4. Models of care for falls and fracture prevention A comprehensive geriatric assessment underpins the management of people who are prone to falls. There are many

models of care that are fashioned according to existing services in different regions and countries. Many are based on the American Geriatrics Society/ British Geriatrics Society Clinical Practice Guidelines, ‘Prevention of Falls in Older Persons’. For those older people who have a had a fragility fracture, as- sessment of falls and fracture risk is essential, and the Fracture Liaison Service model of care has become an established standard. The aim of such a service is to improve the secondary prevention of fragility fractures by improving the identification and treatment of osteoporosis, but also to reduce the risk of further falls by linking the affected individuals with falls services.
A systematic review and meta-analysis reported different types of Fracture Liaison Service models: some were all-encompassing and delivered identification, investigation, and initiation of interventions; some delivered iden- tification and investigation, but relied on initiation of interventions by the primary care physician; some delivered identification and sent an alert to the primary care physician that further inves- tigations are needed, but relied on the primary care physician to organize those investigations and appropriate interventions; and Box 6.8.2 Summary of the Results of Cochrane Systematic Review: Interventions for preventing falls in older people living in the community Interventions that reduced the rate of falling and risk of falling (Gillespie et al., 2012): • Group and home-based exercise that included both balance retraining and muscle strengthening components (rate ratio (RaR) 0.71, 95% con- fidence interval (CI) 0 .63–0.82 for rate of falls and risk ratio (RR) 0.85, 95% CI 0.76–0.96 for risk of falling) • Tai chi (balance-based exercise) (RaR 0.72, 95% CI 0.52–1.00 for rate of falls and RR 0.71, 95% CI 0.57–0.87 for risk of falling) • Home safety interventions, especially those delivered by an occupa- tional therapist (RaR 0.69, 95% CI 0.55–0.86 for rate of falls, and RR 0.79, 95% CI 0.70–0.91 for risk of falling) Interventions that reduced rate of falling but not risk of falling: • Multifactorial interventions including an individualized risk assessment (RaR 0.76, 95% CI 0.67–0.86) • Pacemaker insertion for people with confirmed cardio-inhibitory ca- rotid sinus syndrome (RaR 0.73, 95% CI 0.57–0.93) • Expedited first cataract extraction surgery in women, but not second cataract surgery (RaR 0.66 95% CI 0.45–0.95) • Gradual withdrawal of psychotropic medications (RaR 0.34, 95% CI 0.16–0.73) • Antislip shoe devices for icy weather (RaR 0.42, 95% CI 0.22–0.78) • Podiatry and foot and ankle exercises in people with foot pain (RaR 0.64, 95% CI 0.45–0.91)

6.8 Falls, faints, and fragility fractures 587 some models provided education to the patient, but did not alert the primary care physician. Special considerations and uncertainties Falls in hospital Inpatient falls are the most commonly reported patient safety inci- dent in UK hospitals. Over 600 inpatient falls are reported per day in acute hospitals in England and Wales, amounting to over 240 000 falls and 2500 hip fractures annually among acute inpatients in this territory (see also Chapter 6.5). The Royal College of Physicians National Audit of Inpatient Falls in 2015 reported a fall rate of 6.63 per 1000 occupied bed days, while in the United States rates of falls in hospitals range from 3.3 to 11.5 falls per 1000 patient days. At one end of the spectrum, inpatient falls can impact negatively on a patient’s function, confidence, recovery time and length of stay: at the more serious extreme they can result in severe harm due to hip fractures, head injury, and even death. Many of the falls risk factors in older adults in hospitals are unchanged compared to those in a general older population. However, the coexistence of acute illness, delirium, cognitive impairment, urinary incontin- ence, sleep disturbance, impaired mobility, new medications, and environment change associated with a hospital stay further amp- lify an individual’s risk of falls. A Cochrane review in 2012 found that, in contrast to multifac- torial interventions to reduce falls in community-dwelling older adults, there is little conclusive evidence that a similar standard multifactorial approach reduces falls in the acute hospital setting. More recently a plausible ‘6-Pack’ programme

comprising a nine- item falls risk assessment with six nursing interventions—‘falls alert’ sign; supervision of patients in the bathroom; ensuring pa- tients’ walking aids are within reach; establishment of a toileting regime; use of low-low beds; and use of bed-chair alarms—failed to out-perform standard care in a randomized trial. Identifying the specific risks in potentially vulnerable individ- uals may be a more effective strategy as there is no ‘one size fits all’ assessment to detect reliably those most at risk. The individualized approach takes account of baseline risk factors and the effect of concomitant illness and treatments. There may be a role for multi- factorial interventions, including exercise, in the subacute ward setting where patients have longer lengths of stay. Hip protectors Hip fractures usually result from a fall. Hip protectors are designed to reduce the forces impacting the hip in a sideways fall, thereby lessening the chance for a femoral neck fracture. The protectors are placed or sown on each side of an undergarment. Although some individual trials have confirmed that they can reduce hip fractures, others have shown negative results, probably related to problems with adherence and persistence, with compliance rates generally varying between a third to two-thirds only. A Cochrane review in 2014 included 19 controlled trials that compared a hip protector intervention group with a control no hip protector group, and found a small but significant 18% reduction in hip fracture risk for people in nursing or residential care settings. However, no beneficial effect was seen in a community-dwelling setting. Nevertheless, where an older person continues to have re- current falls despite assessment and intervention, hip protectors may be worth considering in individuals who will wear them. Vitamin D controversies Vitamin D deficiency is associated with impaired balance, low bone mineral density, muscle weakness, and increased risk of falls. Serum 25 dihydroxy vitamin D levels of 20 ng/ml (50 nmoles/l) to 30 ng/ml (75nmoles/l) have been proposed, below which vitamin D levels are thought to be inadequate. Supplementation has been shown to improve muscle strength and balance, thereby reducing falls. Meta-analyses in older adults with vitamin D deficiency have found that doses of 700–1000 IU of vitamin D daily reduces the risk of falling by up to 19%. Care home residents have high prevalence of vitamin D defi- ciency and current recommendations are to consider vitamin D supplementations for care home residents without the necessity to confirm deficiency on blood tests. In clinical practice, vitamin D is often co-administered with calcium supplements as metanalyses have demonstrated the need for both calcium and vitamin D sup-plementation to reduce fracture risk. In 2011 concern was raised about adverse cardiovascular mor- tality in association with calcium supplements. Vitamin D alone has not been found to affect cardiovascular risk, but guidance on the use of calcium and vitamin D in combination, which is most frequently found in clinical practice, remains uncertain. A meta- analysis in 2015, looking specifically at reported cardiovascular outcomes in subjects co-administered calcium and vitamin D, concluded that the guidelines on calcium and vitamin D supple- mentation should not change until randomized controlled trials have been conducted where cardiovascular mortality is the pri-mary outcome measure and findings are adequately adjusted for major confounders. Anticoagulation for atrial fibrillation Atrial fibrillation (AF) affects 4–8% of people aged over 60, and oral anticoagulation with warfarin, and now the newer direct oral anti- coagulants, is associated with a significant reduction in the risk of stroke and other thromboembolic sequelae. Despite this evidence, the rate of prescription of oral anticoagulants in older adults with AF is as low as 50% of those suitable for the treatment. Concern about the risk of falls and associated severe harm is most frequently cited as the reason for nonprescription. However, the rate of subdural haematoma on oral anticoagulants in older adults with an average risk of stroke is low, with an estimated need for the individual to fall up to 300 times per year for the risk to out- weigh the potential benefits from a thromboembolic viewpoint. The newer direct oral anticoagulants confer benefits to the patient in

terms of nonvaried dosing, lack of need for repeated blood tests for monitoring, reliable therapeutic effect, and improvement in overall control for patients who have very labile international normalized ratios (INRs) and limited time in the therapeutic range on warfarin. They would seem to offer an alterative in patients deemed at added risk of adverse outcomes due to high INRs, but the current lack of established antidotes for reversal of each direct oral anticoagulants needs to be considered before their prescription in older adults with

588 Section 6 Old age medicine AF. The decision on whether or not to anticoagulate a patient with AF who is at very high risk of falls is an individualized one, taking into account the patient`s frailty, cognitive state, comorbidities, and (where appropriate) their personal viewpoint. FURTHER READING Barker AL, et al. (2016). 6-PACK programme to decrease fall injuries in acute hospitals: cluster randomised controlled trial. BMJ, 352, h6781. British Orthopaedic Association (2007). The Care of Patients with Fragility Fracture. http://www.bgs.org.uk/index.php?option=com_content&view=article&id=338:bluebookfragilityfracture&catid= 47:fallsandbones&Itemid=307 Challoumas D, et al. (2015). Effects of combined vitamin D-calcium supplements on the cardiovascular system: should we be cautious? Atherosclerosis, 238, 388–98. Ganda K, et al. (2013). Models of care for the secondary prevention of osteoporotic fractures: a systematic review and meta-analysis. Osteoporos Int, 24, 393–406. Gillespie LD, et al. (2012). Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev, 2, CD007146. Kanis JA, et al. (2008). FRAX and the assessment of fracture prob- ability in men and women from the UK. Osteoporos Int, 19, 385–97. Moya A, et al. (2009). Guidelines for the diagnosis and management of syncope (version 2009). Eur Heart J, 30, 2631–71. Muir SW, et al. (2012). The role of cognitive impairment in fall risk among older adults: a systematic review and meta-analysis. Age Ageing, 41, 299–308. National Institute for Health and Care Excellence (NICE) (2012). Osteoporosis: Assessing the Risk of Fragility Fracture. Clinical guideline [CG146]. https://www.nice.org.uk/guidance/cg146 National Institute for Health and Care Excellence (NICE) (2013). Falls: Assessment and Prevention of Falls in Older People. Clinical guideline [CG161]. https://www.nice.org.uk/guidance/ cg161 Panel on Prevention of Falls in Older Persons, American Geriatrics Society and British Geriatrics Society (2011). Summary of the updated American Geriatrics Society/British Geriatrics Society clinical guideline for prevention of falls in older persons. J Am Geriatr Soc, 59, 148–57. Shaw FE, et al. (2003). Multifactorial intervention after a fall in older people with cognitive impairment and dementia presenting to the accident and emergency department: randomised controlled trial. BMJ, 326, 73. Tinetti ME, Speechley M, Ginter SF (1988). Risk factors among elderly persons living in the community. N Engl J Med, 319, 1701–7. Zarraga IGE, Kron J (2013). Oral anticoagulation in elderly adults with atrial fibrillation: integrating new options with old concepts. J Am Geriatr Soc, 61, 143–50. Ziere G, et al. (2006). Polypharmacy and falls in middle age and elderly population. Br J Clin Pharmacol, 61, 218–23.

Revision #1
Created 2026-01-22 16:44:38 UTC by Omar Ayman
Updated 2026-01-22 16:44:39 UTC by Omar Ayman