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FALLS AND THE OLDER PERSON

Series on Clinical Management

Problems in the Elderly

No 6

Report of the Health Care Committee
Expert Panel for health care of the elderly

NHMRC

National Health and Medical Research Council

Executive summary

- At least one-third of people above the age of 65 fall one or more times a year.
- Major physical injuries are relatively uncommon, but are often associated with ongoing disability.
- Psychological sequelae, such as fear, occur frequently and may lead to increased dependence.
- There are physical, psychosocial and financial costs to the injured person and their carers and financial costs to the community.
- The cause of falls is usually multifactorial involving combinations of age-related physiological decline, chronic disease, medication and environmental hazards.
- A multidisciplinary approach is often indicated for the assessment and treatment of people who repeatedly fall.

Introduction

Falls are a major problem for the older person, with a significant morbidity and mortality. Overall at least one-third of people above the age of 65 fall once or more per annum. However, for the older person the problem is not just the greater propensity to fall, but also the increased liability to sustain an injury following a fall. Injuries such as fractures and lacerations demand prompt attention. The more subtle psychological sequelae such as anxiety and fear of further falls are often neglected but may cause restriction of activity, increasing dependency and institutionalisation. In general, the causes of falls are multifactorial and a multidisciplinary approach is essential.

This review will examine in greater detail the magnitude of the problem, the consequences of falling and management strategies. A final section describes primary prevention which may circumvent the progressive decline in function that is often evident in older people with this problem.

Definition

One of the problems of reviewing the literature on falls is the lack of standard definitions which makes it difficult to compare studies. The most generally accepted definition of a fall is as 'an event which results in a person coming to rest inadvertently on the ground or other lower level and other than as a consequence of the following: sustaining a violent blow, loss of consciousness, sudden onset of paralysis (as in stroke), or epileptic seizure'¹.

There is no consensus regarding the definition of those people for whom the frequency of falling becomes a specific problem needing attention. We have therefore defined such a person as someone who has had one or more falls in the preceding year, in circumstances where a fall would not normally be anticipated.

Characteristics

Age

In general, it can be stated that the incidence of falls increases with age. For older people living in the community the prevalence of falls has been found to increase from 35 per cent for 65 to 79-year-olds, to 45 per cent for 80 to 89-year-olds and 55 per cent for those older than 90². There has been some controversy over whether there is an increase in the prevalence of falls above the age of 85. Studies vary, with some showing increasing rates with age, whereas others show a decline particularly in males. Overall, it can be concluded that although age, appears to be a risk factor for falls, this is not a simple relationship. Not all populations show an increase with age, especially when other factors such as disease are constant. The association between age and falling does not necessarily remain at all ages.

Gender

Falls occur more frequently among women than men at all ages. This is confirmed when fall rates are adjusted to allow for the greater numbers of older women.

Dependency level

Older people living in institutional care have higher rates of falls than those in the community, and the gender difference persists. This is not surprising given the frailty of people in institutional care. Rates for falls are lower in purpose-built geriatric institutions, however, compared with others.

Risk factors for falls

The causes of falls are usually multifactorial involving a combination of intrinsic factors, extrinsic factors and drugs. Intrinsic factors refer to age-related physiological decline and disease states, and extrinsic factors are environmental hazards and activity-related risks. Theoretically, drugs should be considered an extrinsic factor. However, due to their importance as a risk factor they are considered as a separate group. It is uncommon to find a single cause for falls. However, intrinsic factors become increasingly important in people over the age of 75.

Medical

The control of balance is highly complex, but in principle there are three major components in the balance control servomechanisms. Sensory input from visual, vestibular and somatosensory systems provides information about the displacement and position of the body. Central processing at various levels in the brain synthesises the sensory input and calculates the adjustments necessary to maintain balance. These messages are relayed from the brain via the spinal cord and peripheral nerves to the muscles which initiate the corrective adjustments necessary to maintain balance. Age-related physiological decline in all these systems results in a reduction in the safety margin for maintaining balance. In healthy older people this safety margin remains adequate under routine circumstances (see Table 1).

In addition to these age-related deficits, there are many pathological conditions that occur frequently in older people that interact to increase the risk of falls, as can be seen in Table 2. This is not an exhaustive list but highlights the complexity of the problem.

As well as these chronic diseases which contribute to ongoing balance impairment, acute problems — such as vestibular neuronitis, pneumonia and myocardial infarction — may transiently compromise balance control and predispose to falls. Although syncope is classified separately to falls, when an adequate history is not available, a review of causes of syncope such as epilepsy and cardiac arrhythmia is appropriate.

Drugs

Drug therapy is occasionally the primary cause of falls in older people and is often a contributing factor. All those who fall should have their drug therapy regimen reviewed. Drugs act to increase the likelihood of falls by a number of mechanisms (see Table 3)³.

Central nervous system depression

Many drugs have a depression of central nervous system function as either a direct therapeutic action or side-effect (eg hypnotics, sedatives, tranquillisers, antidepressants and anticonvulsants). Even when drowsiness is not reported by the patient an increase in postural sway on standing can be tested. There is a probable association between the degree of postural sway and the incidence of falls. Central nervous system depression impairs balance reactions, and thus increases the risk of falls if balance is perturbed.

Postural hypotension

The regulation of blood pressure with changes in position from lying to standing is controlled by baroreceptors in the carotid artery and elsewhere. A fall in blood pressure of 20mm Hg systolic and/or 10mm Hg diastolic is considered to be abnormal and increase the likelihood of falls. Drugs likely to cause postural hypotension include antihypertensives, diuretics, major tranquillisers, antidepressants and drugs for Parkinson's disease.

Parkinsonian symptoms

Antipsychotic drugs commonly produce parkinsonian-like side-effects with increased muscle tone, paucity of movement and impairment of balance reactions thereby increasing the risk of falls. Prochlorperazine and metoclopramide, drugs which are commonly used in older people to help control dizziness and nausea, are common causes of these types of extrapyramidal syndromes.

Central nervous system toxicity

Antiepileptic drugs in particular may cause unsteadiness and uncoordination by an action on the cerebellum. Clinical signs of toxicity such as uncoordination and nystagmus should be looked for in all patients on antiepileptic medication and drug levels measured when appropriate.

Alcohol

Alcohol is known to facilitate the central nervous system effects of any concurrently administered sedative drugs. It also has direct effects on the central nervous system, producing drowsiness and impaired balance reactions. Recent alcohol ingestion is a common finding in people presenting to hospital Accident and Emergency departments following a fall.

Pharmacokinetics, pharmacodynamics and polypharmacy

Age-related changes in drug clearance, in older people, by both renal and hepatic mechanisms and altered sensitivity to some drugs may result in increased side-effects. This is most pronounced with polypharmacy where multiple drug actions and side-effects may be additive and lead to further falls, for example, by increasing sedation or causing postural hypotension.

Extrinsic factors

Extrinsic factors include both activity-related risks and environmental hazards. They may act independently or through their combined effect, and will vary according to each individual.

Activity-related hazards arise out of many and diverse daily living tasks. People affected by falling are much more likely to demonstrate increased dependence in self-care and personal activities, including maintenance of hygiene, dressing and mobility. Domestic tasks, home management and some community involvement place more complex demands on balance control than personal tasks, and therefore are likely to be impaired earlier⁴. Such activities include meal preparation, bed-making, gardening, shopping and use of public transport.

The environment in which an activity is performed must also be considered as a potential risk. Obvious, recognised hazards include stairs, wet or uneven surfaces, electrical cords, loose scatter rugs and pets. Furniture can create problems because of instability, location and particularly seat height, which is frequently too low for lounge chairs and toilet seats. Lighting can also be a problem, either due to glare from polished surfaces, or insufficient illumination to identify hazards such as stairs and kerbs. The floor plan of a house may be inappropriate with, for example, an external toilet or bathrooms and kitchens which are too small for the use of walking aids and wheelchairs.

Consequences of falling

Morbidity

The most likely outcome following a fall is that no physical injury is sustained. Of the physical injuries that do occur most are minor injuries such as abrasions, bruising and joint sprains. Fractures occur in 5 to 10 per cent of falls and the sites of fractures are approximately — one-third lower limb, one-third upper limb and one-third other sites including vertebrae and ribs. Major injuries other than fractures occur in another 5 to 10 per cent of falls, and include head injuries, joint dislocations and lacerations requiring suturing.

Less well recognised are the psychological sequelae following a fall. At least 50 per cent of people who fall are frightened of having further falls and about 25 per cent limit activities such as use of public transport and performance of domestic tasks⁵. Gait abnormalities, over reliance on walking aids and 'furniture walking' have all been observed following falls, in the absence of neurological and orthopaedic problems. This has been termed the 'post-fall syndrome' and may be a phobic anxiety reaction to the fear of further falls⁶. Fear of falls can also occur prior to a fall and may be an indicator of impaired balance. These psychological reactions result in decreased activity, gait disturbance and increased dependence with the risk of institutionalisation. In one study 40 per cent of people seeking nursing home admission stated falls were a major factor in planning a change of accommodation⁷.

Mortality

The death rate from falls is difficult to calculate as the consequence of the fall, for example, fractured neck or femur, is more likely to be recorded on the death certificate than the fall itself. In the United States of America accidents are the fifth leading cause of death in people above the age of 65 and falls constitute two-thirds of these injuries. In Australia, figures are available for external causes of death which includes falls, motor car accidents, suicides, burns⁸. For people aged greater than 75-years falls account for 55 per cent of these deaths compared with 13.4 per cent in 55 to 74-year-olds and 2.1 per cent for 18 to 54-year-olds. Although older women account for a greater percentage of falls deaths than older men, when the figures are adjusted for population distributions, the falls death rate for men and women is approximately equivalent, with men greater than 80 years being at a slightly higher risk of death.

Management following a fall

Management following a fall comprises treatment of the injury, treatment of the underlying cause and rehabilitation. The occurrence of a fall is a non-specific marker of disease and signals the need for a full evaluation of a patient's problems. Usually this requires multidisciplinary management from a range of health professionals including medical practitioners, physiotherapists and occupational therapists.

Medical

After any injuries sustained have been treated, pathological processes likely to result in falls need to be ascertained. These might include central nervous system diseases such as Parkinson's disease, cardiac rhythm abnormalities, arthritis, or orthopaedic problems presenting with gait abnormalities or postural hypotension. A full medical history, including drug therapy, and physical examination is required with special reference to cardiovascular, visual, neurological and musculoskeletal examinations. Cognitive function should be assessed. Blood pressure must be checked both lying and after standing for one, two and five minutes.

Gait should be observed both with and without walking aids if possible. Patterns of gait abnormalities should be determined if possible, for example ataxic, spastic, extrapyramidal and dyspraxic. Simple tests of static and dynamic balance should be performed. Static balance can be assessed by observing body sway when standing still and a Romberg's test making sure that precautions are taken to prevent the patient from falling. Tests for dynamic balance should evaluate the ability to balance during self-generated perturbations, for example reaching and turning, as well as externally generated perturbations, for example, response to a sternal push.

The investigations ordered are determined by the clinical presentation. X-rays may be needed to exclude a fracture. Electrolytes, full blood examination and renal function should be tested in the presence of postural hypotension. Electrocardiography and chest X-ray may be needed for the evaluation of cardiac function. CT scanning of the brain may be indicated, particularly if upper motor neurone focal neurological and frontal lobe signs exist. Imaging of the spinal cord (MRI or myelography) should be secondary to specialist referral.

A full review of the patient's medication should be undertaken. Drugs causing central nervous system depression should be eliminated if at all possible and the synergistic effects of all centrally acting drugs should be considered. Drugs such as prochlorperazine that are used to control dizziness are seldom of benefit in the chronic situation and are best withdrawn in view of the risk of parkinsonism and hypotension. Similarly, antipsychotics are best avoided.

Physiotherapy

A number of physical functions may be reduced after a fall, either due to primary pathology, or secondary to the fall. These include reduced muscle strength, reduced standing balance and impaired gait all of which may lead to loss of confidence^{9,10}. Each of these factors may be amenable to full or partial remediation by the implementation of an exercise and balance retraining program.

In older people regular exercise has been shown to be beneficial in improving cardiovascular fitness, muscle strength and flexibility. General exercises, such as walking, exercising in water, and riding an exercise bicycle, can improve these general fitness parameters. These types of exercises can be undertaken by most older people as long as they start slowly and gradually increase the intensity and duration of the program. Even activities which are not generally perceived as exercise, such as shopping and walking, are important. Studies evaluating the effectiveness of balance retraining in the older person, especially those who have experienced falls, have not been conclusive^{11,12}. This may, in part, be due to methodological problems. Nevertheless, physiotherapists regularly assess balance in older people who have experienced a fall and provide balance exercises when considered appropriate.

Given the complex aetiology of falls in older people, it is not possible to devise a standard exercise program which will be suitable for all. Instead exercise programs need to be tailored to the specific balance deficits identified on each individual's assessment. For example, if a person has a tendency to fall backwards an exercise rocking back onto the heels, within the person's base of support, may improve performance in high-risk situations. This exercise stresses balance control mechanisms and also allows the person to practice balance saving strategies, such as leaning forward and using arm movements for additional stability. All balance exercises must be performed at a level that stresses balance control. Often this can be done at home in a safe environment, for example, between two chairs to provide support if required. However, some people will require supervision either because of cognitive impairment or the severity of the balance disorder, and a day hospital or community health centre may become appropriate venues. Following a fall, loss of confidence and fear of further falls can lead to reduced activity. Unless addressed promptly this can result in further weakness, balance and gait disturbances and further loss of confidence. Therefore, early physiotherapy intervention is a vital component in management.

As it is impossible to prevent all falls, it is important for people with falling problems to attempt to reduce serious injury in two ways. The first of these is to learn to fall safely and, therefore, diminish the risk of a major injury. For example, rolling the shoulder forwards as the fall occurs may limit the severity of injuries sustained. Secondly, it is important to get up from the floor following a fall, as a long lie following a fall is associated with increased morbidity. Although a serious injury may make a long lie unavoidable, a number of people do not get up from a fall even in the absence of injury, leaving them at greater risk of pressure sores, hypothermia and dehydration etc. Providing that no serious injury has occurred, rising from a fall is usually most easily performed by rolling onto the side with the knees flexed, moving onto the hands and knees, then crawling to a stable object which can be used for support. From this position the person straightens so they are kneeling upright, bends one leg forward with the foot in front, and then uses this leg and a hand support to pull up to standing. Recent studies have also assessed the effectiveness of protective hip padding being used by those at risk of falling. The results are encouraging with respect to a reduction in hip fractures, but acceptability of this padding has been a problem.

Occupational therapy

Occupational therapy following a fall is based on assessment of the individual's capabilities, needs and limitations, the role of the family, community supports (both formal and informal) and environmental considerations. Key domestic tasks, which stress balance control, include meal preparation, carrying objects, reaching and bending to access cupboards or hanging out washing, and shopping, all of which are readily assessable.

A home visit is usually indicated to assess environmental hazards and recommend appropriate modifications. Comprehensive checklists of environmental hazards are available and ensure that all major potential risks are addressed¹³. All rooms of the house are assessed as well as access and the external environment. A few examples of the types of interventions that may result following a home visit include:

- **stairs:** installation of rails, widening of steps to accommodate walking aids, conversion to a ramp;
- **floors:** removal of clutter and scatter rugs, appropriate location of telephone and electrical extension cords;
- **toilets:** rails, raised toilet seats, utilisation of commodes or urinals for more ready access particularly at night; and
- **domestic activities:** long-handled equipment and trolleys to reduce bending and carrying.

Although many of the above suggestions appear relatively simple, their implementation may be quite difficult as they can challenge the values, personal habits, self-esteem and customs of individuals, and can also be financially prohibitive.

Following a home visit it may become apparent that despite modifications some activities remain a high risk for falls. The person may require assistance from family or support services such as housekeeping assistance, provision of meals, home nursing and home maintenance programs. At times, referral to a day hospital is indicated to practise personal and domestic skills under supervision with a particular emphasis on safety.

A number of older people wish to continue living at home, even when at risk of falling, and in such circumstances a personal alarm may provide the communication link that renders independent living feasible.

Falls prevention

Primary prevention

Primary prevention is the identification of risk factors in advance of a fall in order to prevent them occurring. Given the complex interaction of age-related physiological decline, chronic disease, medication and the environment, it is obvious that intervention has to occur before people reach older age. The impact of chronic disease and medication can certainly be modified by a healthy lifestyle from early life, including cessation of smoking, moderation of alcohol intake and regular exercise. Age-related physiological decline, such as muscle weakness and decreased aerobic capacity, can be slowed by regular exercise. Environmental modification is an important safety precaution both within and outside the house.

Two prospective studies looking at risk factors for falls have been undertaken. The first did not look at gender differences and identified sedative use, cognitive impairment, palmomental reflexes, lower limb disability and abnormalities of feet, gait and balance as significant risk factors⁵. The risk of falls increased linearly with the number of risk factors. The second study assessed gender differences⁴. The risk factors for men were decreased physical activity, stroke, arthritis of the knees, gait abnormality and increased static sway. In women the factors were muscle weakness, standing systolic blood pressure of <110, psychotropic drugs and medication liable to cause postural hypotension.

A locally produced resource book, called *Stay on your feet: information and suggestions on preventing falls*, addresses many of the issues facing a fall prone older population¹³. In the future, additional resources in the form of 'Accident Prevention Units', akin to similar projects for children, may become available.

Secondary prevention

Secondary prevention is the identification and rectification of risk factors at the time of a fall and is aimed at preventing a recurrence. The aims are the same as for primary prevention, but the scale of the exercise is economised by restriction of the intervention to a selected population. Secondary prevention requires a holistic multidisciplinary approach, as discussed under the section on management, with input from doctors, physiotherapists and occupational therapists and access to other health professionals including psychologists and social workers. This requires a considerable degree of coordination and is probably best managed in special clinics such as Falls and Balance Clinics^{14,15}.

These clinics have the expertise to address all facets of the causes of falls, and also to prescribe and monitor response to therapy in cases which do not respond to simple management strategies.

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Conclusions

Falls are a common problem that can threaten the life or independence of the older person. Multiple factors are often involved in the aetiology. Although intrinsic factors become increasingly important with advancing age, these often interact with the environment and medications, resulting in a cumulative effect. Looking for a single cause of falls over-simplifies the problem. Instead, a multifactorial, multidisciplinary approach is the most appropriate approach for people who have had recurrent falls. Having defined the risk factors for an individual, a multifaceted treatment strategy is devised. Medications and environmental hazards are potentially remediable, whereas impaired balance, secondary to intrinsic factors, may not respond to rehabilitation. Therapy directed at secondary disuse and psychological sequelae is also important to prevent a progressive decline in function. As well as focussing on secondary prevention, research in recurrent falling is also trying to elucidate predictive factors for falling, thereby enabling the establishment of primary preventive programs.

Summary points

- The cause of falls is generally multifactorial.
- Try and identify a major causative diagnosis if possible.
- Identify additional diagnoses that may contribute to the risk of falls.
- Review medications.
- Consider environmental modification.
- Aim to maximise general fitness.
- Consider referral for muscle strengthening and balance retraining.
- Prescribe aids that reduce the risk of falling or facilitate prompt attention following a fall.
- Aim to identify individuals at high risk of falling.

Tables

Table 1: Age-related physiological decline increasing the risk of falls

Visual	Visual acuity Contrast sensitivity Visual field Depth perception
Proprioception	Vibration sensation Joint position sensation Nerve conduction Threshold for excitability Degeneration of cervical mechanoreceptors
Central	Reaction time
Muscle	Mass Strength Endurance

Table 2: Chronic diseases increasing the risk of falls

Musculoskeletal	Osteoporosis Osteoarthritis Foot disorders Disuse muscle weakness
Neurological	Dementia Extrapyramidal disorders Cerebrovascular disease Peripheral neuropathy Cervical myelopathy Gait dyspraxia
Visual	Cataracts Glaucoma Macular degeneration
Cardiovascular	Orthostatic hypotension Arrhythmia
Psychological	Depression Anxiety

Table 3: Drugs that increase the risk of falls

Drug	Mechanism
Minor tranquillisers and sedatives (eg benzodiazepines)	Central nervous system depression Postural hypotension
Major tranquillisers (eg phenothiazines)	Central nervous system depression Postural hypotension Parkinsonian symptoms
Antihypertensives (eg ACE inhibitors)	Postural hypotension
Anticonvulsants	Central nervous system depression Cerebellar effects
Diuretics	Postural hypotension
Antidepressants	Central nervous system depression Postural hypotension
Alcohol	Central nervous system depression Impaired balance
Antiemetics (eg prochlorperazine)	Parkinsonian symptom

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Foreword

About one-third of people above the age of 65 fall once or more each year. However, the problem is not just the greater propensity to fall, but also the increased ability to sustain an injury following a fall. In general the causes of falls are multifactorial and a multidisciplinary approach is essential. This paper examines the magnitude of the problem, consequences of falling and management strategies. It also describes primary prevention which may circumvent the progressive decline in function and increasing dependency that is often evident in older people who have experienced a fall.

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