

Health Care for Older People

Holistic Approach

Stability & Mobility

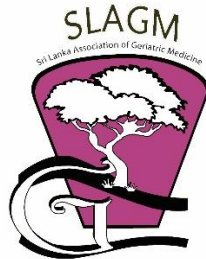
Sri Lankan Association of Geriatric Medicine

2019

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Holistic Approach

Stability & Mobility



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An attempt to develop and promote multidisciplinary mutual coordination and collaboration among the teams involved in care of older patients at various levels in the health and social services sector

'Team work divides the task and multiplies the success'

Editorial Committee

Dr. Thusha Nawasiwatte

MBBS, MD, MRCP (Lond), MRCPS (Glasg)

Dr. Senaka Bandusena

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BSc, Ph.D

Mr. Nandana Welage

Dip (OT), BSc (OT) (SL), MSc (OT) (HK)

Ms. Kalpani Abhayasinghe

BSc (Hons) Nursing, Ph.D (UK)

Contributors

(In order of appearance of articles)

Dr. Chandana Kanakarathne

MBBS, MD, MSc (Geriatric Medicine, Keele, UK), FRCP(Lond)
Consultant Physician & Geriatrician

Dr. Mahilal Fonseka

MBBS, MD, FRCP, Consultant Physician General & Geriatric Medicine,
East Sussex Healthcare NHS Trust, Eastbourne

Prof. Ashish Goel

MD MPH, Associate Professor, Department of Medicine, University
College of Medical Sciences, University of Delhi

Dr. Abhishek Vaingankar

MBBS, MD, Department of Medicine, University College of Medical
Sciences, University of Delhi

Dr. Ruvan Ekanayake

MBBS, MD, MRCP(UK), FRCP(Lond), FRCP(Edin), FRCP(Glsg), FCCP,
FACC, FESC, Consultant Cardiologist / Editor in Chief SLJC

Dr. Champika Gunwardene

MBBS, MD, MRCP, MRCP(Neuro), Consultant Neurologist, GH
Ratnapura

Dr. Lalith S. Wijeyaratne

MBBS, MD, MRCP, FRCP Consultant Rheumatologist

Dr. Chandra Jayasuriya

MBBS, MD, Consultant ENT Surgeon

Dr. Kapila Ranasinghe

MBBS, MD (Psych), FSLPsych – Senior Consultant Psychiatrist, NIMH,
Sri Lanka

Dr. Malsha Gunathilake

MBBS, MD (Psych) – Senior Registrar in old age Psychiatry, NIMH, Sri Lanka

Dr. Manilka Sumanthilake

MBBS, MD, MRCP, MRCP(Endocrine), Consultant Endocrinologist, NHSL, Sri Lanka

Dr. Panduka Karunanayake

MD(Col), FRCP(Lond), FCCP(SL), PgD Appl Sociol (Col) Senior Lecturer in the Department of Clinical Medicine, University of Colombo

Dr. Vathulan Sujanitha

MBBS, MD, FCCP, Senior Lecturer and Honorary Consultant Physician, Department of Medicine, Faculty of Medicine, University of Jaffna

Dr. Jayamal De Silva

MBBS (Colombo), MD (Psychiatry), Consultant Psychiatrist, Senior Lecturer in Psychiatry, Faculty of Medical Sciences, University of Sri Jayewardenepura

Dr. F H D Shehan Silva

MBBS, MD, MRCP (Lond), Dip Med Pract (LSTM UK) MRCP (Diabetes and Endocrinology) MRCP (Geriatrics) IFME (Cantab), AFHEA (UK)

Ms. Theruni Wijewardene

MSc Physio; BSc Sports Sci. Senior Physiotherapist, Visiting Lecturer, Department of Allied Health Sciences, Faculty of Medicine, University of Colombo

Mr. Nandana Welage

Dip OT, BSc OT, (SL), MSc OT (HK) Senior Tutor in Occupational Therapy, School of Physiotherapy and Occupational Therapy, Colombo. PhD Candidate, Western Sydney University, NSW, Australia

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1. Editorial

The Bulletin, "Healthcare for older people – holistic Approach on Stability and Mobility" pursuing the education of the multi-disciplinary team members for the care of elderly is the third of this nature in the series. It is with great pleasure and pride that the Sri Lankan Association of Geriatric Medicine launch this much needed bulletin on 'Stability and Mobility' in order to enhance the knowledge and attitudes of the health care professionals. The series, "Health Care for Older People – Holistic Approach" is available in all medical, nursing, and allied health libraries in Sri Lanka and online from the SLAGM official website. The Sri Lankan Association of Geriatric Medicine looks forward to further widen the readership of the bulletin.

Stability and mobility are essential for independent living. Impaired stability and mobility lead to falls and is common and a leading cause of morbidity in elderly, worldwide. Gait disorders are reported in 25% of individuals between the ages 70-74 and they are as common as 60% in those between the ages of 80-84. Many falls go unreported unless they are very severe.

The Bulletin covers knowledge needed for medical and para medical professionals such as nursing, and allied health fields for management of falls. The normal walking cycle and the abnormal gait patterns are elegantly described by Prof Ashish Goel. All systemic disorders that contribute to falls are discussed in depth by experienced erudite professionals from their respective fields. Overdosing and polypharmacy are relevant and discussed by the consultant physician, Dr. Sujanitha Vathulan. Finally, clinical evaluation of falls is elaborated by Dr. Chandan Kanakarathne, and the role of physiotherapist and occupational therapist in the management of falls also is highlighted.

I take this opportunity to acknowledge the commitment and support extended in providing articles to the Bulletin by all invited authors. The guidance of Dr. Chandana Kanakarathne, Consultant Geriatrician in organizing this issue of the bulletin is praiseworthy.

The series of 'Health Care for Elderly- Holistic Approach' is the brain child of Dr Padma Gunaratne, Consultant Neurologist, President SLAGM. She has been the life and force behind the success and continuity of this publication and was particularly so for this issue. It is my honour bound duty to thank her for the support and guidance given.

It is the fervent wish of the Sri Lankan Association of Geriatric Medicine that knowledge reaped out of the bulletin is made available for use by all professionals for the betterment of all elderly in Sri Lanka.

Dr. Thusha Nawasiwatte
Editor, SLAGM

2. Introduction

Dr. Chandana Kanakarathne

Balance is the ability to distribute body weight in a way that lets a person stand or move without falling. In order to walk one should be able to maintain balance and upright posture with enough muscle strength in legs to move them. Mobility is the ability to move in environment with ease and without restriction. Unaffected balance and gait lead to independent mobility. However, difficulties with one if not both of them are not uncommon in ageing population.

Balance and gait difficulties are important considerations with ageing as they can influence life in many ways. They are among the commonest causes of falls in the elderly and may also increase the risk of 'fear of falling', limitation of mobility, loss of independence, institutionalization and, even death. Quality of life can be severely disturbed as a result.

Balance and gait disorders get worse with advancing age. In one study, gait disorders were reported in 25% of individuals between the ages 70-74 whereas they were as common as 60% in those between the ages of 80-84. Gait and balance disorders may represent development of subclinical disease as evidenced by the correlation with cardiovascular diseases, dementia and increased risk of death.

Balance is needed in order to maintain posture, respond to voluntary movements, and to react to external stresses. To maintain balance, the center of mass should stay within the base of support.

Postural control is primarily regulated by the cerebellum and the vestibular system. However, the postural control also depends on the sensory input from many sources, which include **somatosensory information** from muscle and joint proprioceptors, cutaneous sensory information which identifies surface characteristics, vestibular information for head and trunk orientation in space, gravity information from graviceptors in the trunk, and visual input. Prior experiences can modify them.

Ageing is associated with declining ability to maintain balance. The resulting changes in balance with ageing are discussed in detail in chapter 3.

Gait is controlled by forebrain (basal ganglia, frontal subcortex, and motor cortex), cerebellum, brain stem and the spinal cord. Neural control of gait is divided into separate processes. (Activation and guidance, regulation of gait, and execution)

Up to 20% of adults maintain normal gait pattern into very old age. Changes in gait with ageing are discussed in chapter 3. To understand the changes, one should be familiar with the terminology used for the description of gait (see annexure 1)

CAUSES:

Balance and gait disorders are multi- factorial. Therefore, understanding of the causes will enable to help the patient better. Many cardiovascular diseases, neurological disorders, musculoskeletal disorders, mental health issues, infectious diseases, and metabolic conditions such as diabetes can contribute to balance, gait and mobility difficulties in variable severities. Polypharmacy is a hugely important cause for such difficulties. Sensory impairments such as vision and hearing impairments and peripheral neuropathies may contribute substantially. Acute medical illnesses, recent hospitalizations, and recent surgeries are some other recognized causes^{3,4}. (see annexure 3) These issues will be discussed in detail in subsequent chapters.

EVALUATION AND MANAGEMENT:

These are achieved through multi-disciplinary assessment of the gait, balance and mobility issues while reviewing the causes and the risk factors leading to difficulties with them. Subsequent planning of care for such difficulties is carried out by different professionals working in harmony, coordinated by a geriatrician/physician, in order to achieve the best results. Evaluation and management are discussed in subsequent chapters and summarized in chapters 12 and 13.

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3. Mechanisms Maintaining Mobility & Stability and Factors Leading to their Impairment

Dr. Mahilal Fonseka

Walking is important for activities of daily living. The physiology of walking is complex and needs to be understood to recognize a gait disorder. Failure of this complex control system increases the risk of falls.

Normal gait needs a delicate balance between different interacting neural systems and consists of three components,

- Locomotion (including initiation & maintenance of rhythmic stepping)
- Balance
- Ability to adapt to the environment

Thus, all levels of the nervous system are needed to maintain normal gait.

SPINAL CORD - repetitive, alternating & coordinated movements of limbs are triggered by central pattern generators (CPG) which are segmentally organized in the spinal cord in the newborn. These are modified by sensory feedback and supra spinal controls that overrides CPGs with maturation.

SUPRA SPINAL LOCOMOTOR CENTRES - spinal CPGs are controlled by specific locomotor command regions (LMR) in the brain stem and cerebellum. Brain stem stimulation at various levels in a decerebrate animal produce different movement patterns depending on the level of stimulation. Cerebellar vermis integrates proprioceptive, vestibular and visual afferent input into the locomotor program. Basal ganglia & frontal cortices also input to these LMRs. Cortical executive function is crucial for walking, planning the best route and continuous interaction with environment.

Gait disorders can be classified according to the level of the sensori-motor deficit as low, middle or high although many are multifactorial in origin.

Low deficits

- Sensory (vestibular disorders, neuropathy, visual defects)
- Motor (motor neuropathy, myopathy, arthritis)

Middle deficits

- Spasticity
- Parkinsonism
- Cerebellar ataxia
- (All producing classic gait disorders)

High deficits

- Cognitive impairment (frontal gait pattern)
- Behavioral aspects (fear of falling)

The physical examination should be tailored to look at the following deficits to identify the site of physiological dysfunction which will decide further investigations.

WEAKNESS

The pattern of weakness can be diagnostic of the cause.

- Upper motor weakness usually causes spasticity and weakness affecting hip flexors, foot dorsi-flexors and knee flexors
- Lower motor weakness causes a pattern of weakness depending on site of lesion with possible sensory segmental level or absent reflex.
- Myopathy causes proximal muscle weakness with a waddling gait
- Isolated nerve palsies like common peroneal nerve palsy will cause a foot drop
- Myasthenia causes weakness worsened by repetitive exercise
- Motor neuron disease causes diffuse wasting and weakness, muscle fasciculation and hyperreflexia

LOSS OF SENSORY INPUT

Sensory input is vital for monitoring motor output. The most important modality providing feedback is position sense (proprioception). Vision and vestibular feedback also give sensory input.

- Loss of proprioception is usually due to defects in the posterior columns of spinal cord (and rarely severe peripheral neuropathy, dorsal root ganglion damage or cortical sensory loss). The gait is described as 'stamping' and the Romberg's sign is positive.
- Vestibular dysfunction could present as a gait disorder varying from the occasional stumble to frank ataxia. This is due to the abnormal sensation of rotation despite this being episodic in nature. The important sign to look for is nystagmus.

CEREBELLAR ATAXIA

Gait ataxia (lack of coordination in legs) implies defects in cerebellar vermis or cerebellar connections in brain stem.

This ataxia is restricted to active complex movements with negative Romberg's sign. The gait is wide based, with short stride length and inability to do tandem walking. Dysmetric finger-nose and heel-shin tests are present with generalized hypotonia. The speech is slurred and scanning.

The causes are varied and include hypothyroidism, alcoholism, paraneoplastic syndrome, recurrent head trauma and strokes, encephalitis, autoimmune disorders and neoplastic processes thus extensive investigations are needed.

EXTRAPYRAMIDAL DISORDERS

Hypokinetic extrapyramidal disorders can affect mobility as they cause slowness, akinesia and disequilibrium. Hyperkinetic disorders, like chorea, can also unusually cause gait difficulty.

In idiopathic Parkinson's disease degeneration of dopamine producing neurons (particularly in the substantia nigra of the basal ganglia) lead to removal of cortical influence of inhibition of basal ganglia. Gait

abnormalities are often the presenting features of extrapyramidal disorders.

In Parkinson's disease the gait is narrow based with reduced stride length. The increasingly faster short steps give the appearance of running – festination. The stooped posture with centre of gravity thrown forwards contributes to this gait defect.

Severe parkinsonian gait with freezing affecting lower limbs with sparing of arms (lower half Parkinsonism) is due to white matter ischaemia caused by small vessel disease. This is labelled as Vascular Parkinson's.

Other degenerative conditions also have parkinsonian gait abnormalities as clinical features,

- Dementia with Lewy Bodies (motor parkinsonism, progressive & fluctuating cognitive impairment occurring within 12 months' parkinsonian motor signs, early visual hallucinations, recurrent falls)
- Multiple system atrophy (Parkinsonism with progressive akinesia & rigidity, autonomic failure, ataxic gait, pyramidal signs)
- Progressive supranuclear palsy (early postural instability and falls, gaze palsy, parkinsonism resistant to dopamine therapy, pseudobulbar palsy)

HIGHER LEVEL GAIT DISORDERS

The periventricular white matter has a crucial role in connectivity of gait centres. Modern imaging techniques help to define gait defects by showing abnormalities of temporal lobes, hippocampus and the nigrostriatal system.

Frontal gait disorders are seen with frontal cognitive deficits (slowness of thought, loss of initiation, apathy or disinhibition, loss of judgment and insight). The gait disorder appears as 'ignition failure' – unable to initiate movement forward, feet barely clearing the floor with short stride length and freezing. Frontal ataxic gait resembles cerebellar ataxia and can also appear 'bizarre'.

PSYCHOGENIC FACTORS

These also must be considered when the defects in mobility do not conform to a recognized neurological disorder.

NON-NEUROLOGIC FACTORS

Since deficits in gait are multifactorial in origin a neurological defect may or may not be accompanied by non-neurologic factors.

These could be rheumatological (arthritis, bursitis or tendinitis), cardiovascular (heart failure, intermittent claudication), drug effects or visual failure.

SUMMARY

Recognition of factors impairing mobility is complicated by the fact that multiple causes can contribute to the deficit in the same patient. Meticulous examination and workup is needed for the accurate diagnosis and appropriate treatment when possible.

4. Gait Patterns in Older Persons

Prof. Ashish Goel & Dr. Abhishek Vaingankar

INTRODUCTION

Human gait is a complex phenomenon involving cognitive functions such as planning, memory, coordination, balance, adequate muscle strength, innervation and joint movement. The prevalence of disorders of gait increases as we age. Ten percent of people between the ages 60-69 and 80% of the people over 80 years old have disorders of gait predisposing them to falls¹.

Gait patterns can be assessed through a simple evaluation as a part of a comprehensive assessment of older people. This helps to recognize elderly patients with neurological diseases. An analysis of gait should be aimed at undertaking preventive measures rather than just solely identifying diseases. In addition, psychological factors such as a fear of falling may also affect different parameters of gait in the elderly and should be addressed adequately.

Falls are an important public health challenge for both developed and developing countries struggling to provide optimum care to their ageing populations. A fall is a classic geriatric syndrome which is one end point of a complex interplay of multiple etiologies and conditions. An older patient with acute pneumonia may just present with a fall without any other classic symptoms that have been traditionally described for such illness. At the same time, a fall may be a harbinger of several other illnesses including but not limited to myocardial infarction, stroke, urinary infection or hyponatremia. At the same time, several gait abnormalities may be identified easily and early in order to allow adequate measures to prevent an unfavorable outcome, reducing both morbidity and mortality besides improving disease adjusted life years.

Falls are an important cause of morbidity and mortality in any elderly population.² Epidemiologically, half the falls in the elderly occur at some point during locomotion. Common causes of falls in the elderly include, visual disturbances, orthostatic hypotension, disorders of gait, incorrect

footwear, lack of adequate support, poor lighting conditions etc. Slipping, tripping or stumbling can also lead to falls⁴. Both the number of falls and the severity of the outcome of such falls increase with age.

DISCUSSION

The gait of an individual, changes with age. Identifying different gait patterns may help clinicians to spot people with a risk of falls thus enabling them to take corrective measures. Certain pathological gait patterns may even point towards underlying neurological diseases.

Walking Cycle

In order to understand the abnormalities in gait, it is prudent to discuss the normal walking cycle before addressing the pathology. Gait denotes the ability of the lower limbs to push the center of gravity forwards whereas mobility denotes the ability to move about in the environment without restriction.⁵ Gait is a complex interplay between the nervous and the musculoskeletal systems.

A typical gait cycle is broadly divided into the swing phase and the stance phase. Walking requires an upright position with fully functioning anti-gravity muscles and intact postural reflexes.⁶ A greater amount of time is spent in the stance phase with the stance phase contributing to about 60% of the gait cycle and the swing phase contributing to 40%.⁶ The gait cycle begins with a flexion of the hips and knees causing the leg to be raised. Following this the contralateral leg bears weight and the center of gravity of the body moves forward. The knee then extends, and the heel strikes the ground. The weight of the body is gradually shifted from the heel to the toes. As the weight is being shifted from heel to toe, the contralateral leg is raised and moved forwards. During the walking cycle the arms move freely with the ipsilateral arm being thrust forwards with the contralateral leg. Cognition, visuospatial function, attention and the cerebellum also play important part in gait by helping the individual avoid obstacles and walking safely.⁶

Determinants of Gait⁷

There are six determinants of gait, the combination of which prevents an excessive vertical or horizontal displacement of the center of gravity. These determinants include a 4-degree pelvic rotation to each side, a pelvic tilt of five degrees to each side, knee flexion of 15 degrees, ankle rotation during dorsiflexion, plantar flexion and a relative adduction of the hip joint owing to the tibio-femoral angle.

Normal Changes of Gait in the elderly⁷

A normal gait should be effortless and free flowing. An individual must be able to get up from a chair without help. The arms must swing equally and freely by the sides. No pelvic or head tilt must be visible. There should be no scoliosis or lordosis. The step lengths must be symmetrical. The ankle must dorsiflex for an adequate foot clearance from the ground. The individual must be able to turn 360 degrees easily without any breaks. There must be no signs of waddling and staggering.

As the person ages, physiological changes occur in gait and it is imperative to understand the physiological changes so as to be able to identify pathological ones. The gait *speed* decreases as we age at a general rate of approximately 1% per year above 60 years. A gait speed of less than 1 m/s is usually considered abnormal with a speed less than 0.8 m/s being associated with decreased ambulation and a speed less than 0.4 m/s with dependence on Activities of Daily Living. The *stride* width increases with age. The contribution of different phases of the gait cycle also change as the individual ages with a relatively greater amount of time being spent in hip flexion and ankle plantar flexion. Other changes include, reduced hip extension, increased anterior pelvic tilt and decreased ankle plantar flexion. Shorter stride *length*, slower cadence and increased mechanical work expenditures are also seen among the elderly.⁸

Evaluation of temporo-spatial characteristics of otherwise normal elderly individuals crossing streets has indicated that the elderly find it difficult to cross a road, increase their speed whilst crossing roads, take more steps and consequently are prone to tripping and stumbling.⁹ Older individuals who use walkers to ambulate, show

decreased speed, cadence, step and stride length and an increased support and stance time.¹⁰

Velocity, coordination and balance are important parameters have been used to describe gait.

Velocity: A decreased gait speed implies mobility restrictions and decrease in quality of life. A low gait speed may be a good measure to detect sarcopenia. A low gait speed may increase the risk of institutionalization, hospitalization, disability, falls and deaths.

Balance: Balance is instrumental in achieving a normal gait. Loss of balance may be caused by vertigo, stroke, cerebellar disorders syncope and cardiac disease.

Coordination: Coordination may be defined as a process wherein movement components are organized in time and sequence, to produce functional movement patterns. Strength limits, joint flexibility and perceptual abilities contribute to coordination. Changes in intra-limb coordination as the individual ages predisposes to injurious falls.

Analysis of Gait

Various objective tests of analysis have been described in literature. Normal gait speed is an important marker of the functional status of the individual and has a prognostic significance. The individual is asked to walk for 6 meters. The first meter of the walk constitutes the acceleration phase and the last one meter constitutes the deceleration phase. The speed is measured during 4-meter walk between the acceleration and deceleration phases.

In the *thirty second chair stand test*, subjects are asked to stand up and sit down from a standardized chair within thirty seconds and the number of times they do so is counted. This test is a predictor of strength in the lower body and can predict falls and problems with balance.

Timed Up and Go Test (TUG) Involves getting up from a chair walking a distance of three meters, turning around, returning to the chair and sitting down. Subjects who can complete the tests within 20 seconds are generally independent whereas subjects who require more than 30

seconds are dependent upon others for Activities of Daily Living and have poor scores on the Berg Balance Scale.

The Japanese Orthopedic Association have described the Locomotive syndrome and advised the *two-step test*, the *stand-up test*, and a questionnaire consisting of 25 questions to assess risk. Locomotive syndrome involves reduced mobility due to normal ageing. Under their description decreased mobility as a result of knee osteoarthritis may be categorized under the locomotive syndrome but decreased mobility due to cardiovascular disease is not.

Abnormal Gait Patterns

Abnormal gait patterns associated with neurological conditions may point to underlying diseases and may be helpful as a part of the comprehensive assessment of the older patient.

Frontal lobe diseases may present with ignition failure (in which the patient begins walking having taken 3-4 steps on the spot with his feet barely clearing the ground) or with a *gait apraxia* in which the gait looks bizarre and shows disequilibrium, hesitations while taking turns or loss of righting reflexes with falls.

The disturbance in vestibular dysfunction may vary from *gait ataxia* to staggering. Vertigo is commonly associated with vestibular disorders. Cerebellar disorders may also be associated with abnormal tandem walking.

Stamping gait: De-afferentation may lead to a stamping gait in which the foot is hit hard on the ground to increase sensory compensation

High-steppage gait: Foot drop which often occurs due to a palsy of the common peroneal nerve may lead to a high-steppage gait in which foot is lifted high above the ground for toe clearance.

Festinating gait: Extrapyramidal disorders, the prototype of which is Parkinson's disease present with a festinating gait whereby the person takes short fast steps and may appear as though he/she is hurrying. Severe Parkinson's disease may lead to freezing of gait and difficulty in initiation with large strides.

Astasia-abasia: This psychogenic disorder includes a fairly gross presentation of hysteria defined as an inability to stand or walk in the absence of any other neurologic abnormalities. Such patients have momentary fluctuations of stance or gait, excessive hesitation at the beginning or buckling of knees without falling. Pathological conditions should be carefully excluded among older people before making a diagnosis of a psychogenic gait disorder

Antalgic gait: Non-neurologic gait disorders are often seen in orthopedic disorders such as arthritis, tendonitis or bursitis and relate to pain. Such patients often have what is described as an *antalgic* gait wherein the patient spends the least possible time on the affected foot

Intermittent claudication: Patients with peripheral vascular disease present with intermittent claudication in which calf pain forces them to take rest after walking a certain distance.

CONCLUSION

A careful analysis of gait in the elderly is a simple and effective tool in identifying disease, preventing falls in the elderly. It can also reduce burden on health care expenditure and reduce all cause morbidity and mortality in the elderly.

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5. Cardiovascular causes of Pre-syncope and Syncope

Dr Ruwan Ekanayake

Pre-syncopal and syncopal attacks are basically classified as reflex, orthostatic and cardiac. The following discussion pertains to both pre-syncope and syncope although only the term syncope will be used hereafter.

CAUSES FOR REFLEX (NEURALLY MEDIATED) SYNCOPE

- **Vasovagal:**
 - Orthostatic: standing (less common on sitting)
 - Emotional: fear, pain (somatic or visceral)
 - Instrumentation, blood phobia
- **Situational:**
 - Micturition syncope
 - Gastrointestinal stimulation (swallowing, defaecation)
 - Cough, sneeze
 - Post-exercise
 - Others (e.g. laughing, brass instrument playing)
- **Carotid sinus syndrome:**

CAUSES FOR SYNCOPE DUE TO ORTHOSTATIC HYPOTENSION (OH)

- Drug-induced OH (commonest cause of OH):
e.g. vasodilators, diuretics, phenothiazine, antidepressants

Orthostatic hypotension may be exacerbated by venous pooling during exercise (exercise-induced), after meals (postprandial hypotension) and after prolonged bed rest (deconditioning).

- Volume depletion:
e.g. haemorrhage, diarrhoea, vomiting, etc.
- Primary autonomic failure (neurogenic OH):
e.g. Pure autonomic failure, multiple system atrophy, Parkinson's disease, dementia with Lewy bodies

- Secondary autonomic failure (neurogenic OH):
e.g. Diabetes, amyloidosis, spinal cord injuries, auto-immune autonomic neuropathy, paraneoplastic autonomic neuropathy, kidney failure

CAUSES OF CARDIAC SYNCOPE

Arrhythmias are the primary cause:

- Bradycardia:
 - sinus node dysfunction (including bradycardia/tachycardia syndrome)
 - atrioventricular conduction system disease
- Tachycardia:
 - supraventricular
 - ventricular
- Structural cardiac defects:
 - aortic stenosis,
 - acute myocardial infarction/ ischaemia, hypertrophic
 - cardiomyopathy,
 - cardiac masses (atrial myxoma, tumours, etc.),
 - pericardial disease/tamponade,
 - congenital anomalies of coronary arteries, prosthetic valve dysfunction
- Cardiopulmonary and great vessels:
 - pulmonary hypertension
 - pulmonary embolus
 - acute aortic dissection

In clinical practice, structural heart disease is not the commonest set of causes for syncope. However, they are easy to detect when present by noninvasive imaging. The arrhythmic causes however are paroxysmal, and detection is not always easy.

EVALUATING A CASE OF UNEXPLAINED SYNCOPE

If the cause of syncope is not clear, evaluation is as follows:

- Take a detailed history including drug history and perform a comprehensive physical exam. Check for features suggestive of epilepsy, evidence of heart disease and carotid disease
- Perform first line investigations that include FBC, ECG, 2Decho, Holter, Exercise ECG, Carotid duplex studies, PPBS
- Consider CT brain and neurological assessment.
- Consider doing tilt table testing with or without carotid sinus massage.
- Consider EP studies:
 - Loop recorder for rhythm disturbance
 - Signal averaged ECG
 - Autonomic function testing

THERE ARE CLINICAL FEATURES WHICH SPECIFICALLY INDICATE SEARCH FOR A CARDIAC CAUSE FOR SYNCOPE

- Sudden loss of consciousness followed by myoclonic jerks is often due to a cardiac cause. (e.g. bradycardia or torsade de pointes can cause this clinical picture)
- Presence of *atypical* premonitory symptoms suggests cardiogenic syncope. (e.g. nausea, lightheadedness, palpitations)
- If antiepileptic therapy (with ion channel active drugs) leads to *an increase* in the frequency of syncope, consider drug induced bradycardia.
- When antiepileptic therapy fails to give the expected control in 'epilepsy' a cardiac cause must be sought.

INVESTIGATION FOR A CARDIAC CAUSE OF SYNCOPE

- **Analyze the ECG in detail for:**
 - T inversion in $V_1 - V_3$. This may suggest arrhythmogenic right ventricular dysplasia with or without epsilon waves
 - Q waves of myocardial infarction indicates peri-infarction origin of ventricular tachycardia

- Features of left ventricular hypertrophy may suggest hypertrophic cardiomyopathy
 - QT_c interval
 - Brugada syndrome
 - Bi fascicular block
 - Sinus bradycardia, sinus arrest, 2nd degree heart block
- If the ECG is abnormal as above, perform:
 - Holter monitoring for at least 72 hours
 - Invasive electrophysiological testing
 - If the ECG is NORMAL, proceed as follows:
 - 2D echo for structural heart disease
 - Tilt table testing (Head up tilt testing)
 - Holter for 48 hours at least
 - Carotid sinus massage with monitoring (usually done at the tilt table testing)
 - Implantable loop recording and EP testing may be considered if the likelihood of a cardiac cause for syncope is very high.

WHEN SHOULD CONTINUOUS ELECTROCARDIOGRAPHIC MONITORING (HOLTER MONITORING) BE PERFORMED?

Immediate in-hospital monitoring (in bed or by telemetry) is indicated in high-risk patients.

Holter monitoring should be considered in patients who have frequent syncope or pre syncope (≥ 1 episode per week). External loop recorders should be considered early after the index event and in patients who have an inter-symptom interval ≤ 4 weeks.

Implanted loop recorder (ILR) is indicated in;

- Patients with recurrent syncope of uncertain origin, who have a high likelihood of recurrence within the battery life of the device.

- Patients with suspected or certain reflex syncope presenting with frequent or severe syncopal episodes.
- Patients in whom epilepsy was suspected but the treatment has proven ineffective

Note: Arrhythmic syncope is confirmed when a correlation between syncope and an arrhythmia (bradyarrhythmia or tachyarrhythmia) is detected. Arrhythmic syncope should be considered likely when,

- periods of Mobitz II second- or third- degree AV block or
- a ventricular pause >3 s
- except in young trained persons, during sleep or rate- controlled atrial fibrillation, or rapid prolonged paroxysmal SVT or VT are detected:

WHEN SHOULD AN 'ACTIVE STANDING' CHALLENGE BE PERFORMED?

Orthostatic hypotension (OH) could be confirmed by performing an 'active standing' challenge. The steps of the procedure for active standing challenge is as follows

- Ask patient to have a 'supine rest' for 5minutes. Check BP and pulse.
- Then stand up quickly and 'actively stand' for 3 minutes. Check BP and Pulse.
- Continue for 10 minutes. Check BP and Pulse
- If in doubt proceed to tilt table test.

Syncope due to OH should be considered likely when there is an asymptomatic fall in systolic BP from baseline value ≥ 20 mmHg or diastolic BP ≥ 10 mmHg, or a decrease in systolic BP to <90 mmHg, along with symptoms which are consistent with OH.

Postural Orthostatic Tachycardia Syndrome (POTS) is considered when there is an orthostatic HR increase (>30 b.p.m. or to >120 b.p.m. within 10 min of active standing) in the absence of OH that reproduces spontaneous symptoms.

If the above diagnoses are suspected, an 'active standing' challenge should be performed.

CAROTID SINUS HYPERSENSITIVITY (CSH)

If the patient is over 40 years of age and the cause of syncope is not evident, Carotid Sinus Massage (CSM) testing must be performed. Apply carotid sinus pressure for 5 seconds, with the patient fully monitored with full facilities for resuscitation available.

Note: A positive carotid sinus hypersensitivity may be present in 40% of asymptomatic patients too. Hence it must not be the sole criterion to implant a Permanent pacemaker.

If syncope occurs while doing the CSM, the diagnosis is confirmed. If syncope does not occur but ventricular pauses occur during CSM, it means only 'Carotid Sinus Hypersensitivity' and does not confirm the aetiology of the syncope. A ventricular pause over 3 seconds is considered a positive result. The BP too could drop.

If the CSH is deemed to be the cause of syncope, a dual chamber pacemaker must be implanted. Carotid sinus testing must be avoided in patients with history of TIA, Stroke within past 3 months and in the presence of a carotid bruit.

NEURO-CARDIOGENIC SYNCOPE

Neuro-cardiogenic syncope is the commonest form of syncope. This should never be forgotten when investigating a patient with syncope.

The causes include:

- Vasovagal syncope
- Carotid sinus hypersensitivity
- Glossopharyngeal neuralgia
- Micturition syncope
- Cough syncope
- Valsalva mediated syncope

The following clinical features must be carefully elicited in arriving the diagnosis:

- Precipitating factors are usually present. E.g. Sight of blood, loss of blood, sudden stress, pain or trauma
- Premonitory symptoms are very common. E.g. Nausea, sweating, pallor
- Usually occurs when upright but rarely seen in supine or seated positions also.
- During the attack usually bradycardia occurs with hypotension
- During the attack certain features may occur. E.g. Yawning, restlessness, sighing, hyperventilation
- Period of unconsciousness is very brief. E.g. less than 5 minutes
- Post syncopal effects are common. E.g. Fatigue, pallor, nausea, sweating

If the history suggests a neuro-cardiogenic origin for the syncope, look for the specific category of neuro-cardiogenic syncope from the list given above. Treatment will be specific for each category.

HOW DO I MANAGE VASOVAGAL SYNCOPES?

Once the diagnosis of vasovagal syncope has been made, make an attempt to eliminate the precipitating factor(s) if possible.

- Avoid and discontinue drugs which are vasodilators or cause a loss of water. E.g. amlodipine, hydralazine, diuretics
- The patient must be advised to practice *leg moving, leg tensing* every 10-15 minutes when in the same posture for long.
- First, augment central blood volume. You may advise the patient to drink slightly in excess of need. E.g. Two to three large cups of soup with added salt or two to three 'thambili' a day etc.
- If the lifestyle of the patient does not permit excess of fluid intake, a mineralocorticoid may be used. e.g. Fludrocortisone – 100 mcg daily, increase up to 300 mcg daily as required.

- Compression stockings to the lower limbs may be used.
- Adenosine blocker may be used to suppress Vasovagal syncope. E.g. Theophylline 250-300 mg bd or Caffeine (2 -4 cups of coffee per day)
- Beta blockers may be used with supervision
- Propranolol 40 mg bd/tds or Atenolol 25 mg bd are considered first line therapy by some authorities especially when a sinus tachycardia precedes the syncope.
- Fluoxetine 20 mg mane or Methylphenidate 10 mg bd (long acting preparations may be used) too may be tried in resistant cases.
- As the last resort, a permanent pacemaker may have to be implanted. (Dual chamber pacemaker with a *rate drop response algorithm* is recommended).

HOW SHOULD I TREAT UNEXPLAINED SYNCOPE/ FALLS IN THE ELDERLY?

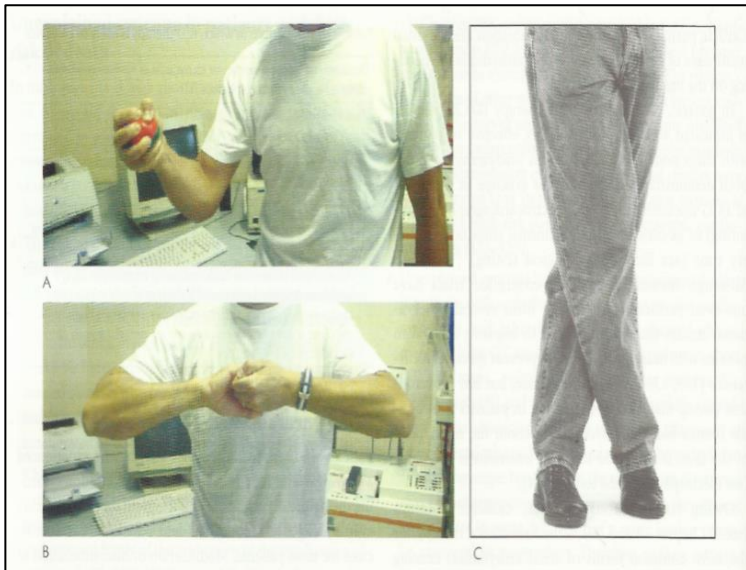
Unexplained falls in the elderly must be dealt as same as for unexplained syncope in the younger population. Special attention must be paid to medications which could lead to hypotension and bradycardia.

Even in the frail elderly patients, the following tests are considered appropriate:

- Carotid sinus massage
- Tilt testing
- Orthostatic BP recording

The management follows from the findings of the test.

WHAT ADVICE SHOULD I GIVE DURING AN IMPENDING FAINTING ATTACK?



The following counter-pressure manoeuvres are recommended as preventive measures when symptoms of an 'impending fainting attack' are noted by the patient:

- **Handgrip:** consists of the maximal voluntary contraction of a rubber ball (approximately 5-6 cm diameter) taken in the dominant hand for the maximum tolerated time or until complete disappearance of symptoms.
- **Arm-tensing:** consists of the maximum tolerated isometric contraction of the two arms achieved by gripping one hand with the other and contemporarily abducting (pushing away) the arms for the maximum tolerated time or until complete disappearance of symptoms.
- **Leg crossing:** consists of leg crossing combined with tensing of leg, abdominal and buttock muscles for the maximum tolerated time or until complete disappearance of symptoms.

THE FOLLOWINGS ARE IMPORTANT INDICATIONS FOR IMPLANTATION OF A PERMANENT PM

The Class I Indications

- 3⁰ heart block with syncope/pre-syncope (N.B. 3rd degree heart block which is *asymptomatic* is only a class IIA indication)
- 2⁰ heart block which is symptomatic
- Bi fascicular heart block which has at any time progressed (intermittently) into 3⁰ or 2⁰ heart block
- Sinus node dysfunction which is symptomatic (*Asymptomatic* sinus node dysfunction where the heart rate is less than 40 is only a class IIA indication)
- Hypersensitive carotid sinus syndrome which is *symptomatic*
- Significant bradycardia of any cause with background disease which has a definite indication for a beta blocker therapy

The following conditions do not need a permanent pacemaker:

- 1⁰ heart block
- Single episode of complete heart block which has been transient.

Implantable cardioverter defibrillators (ICD) are implanted when a dangerous arrhythmia is thought to be highly possible.

An ICD is appropriate when syncope occurs in the following cases: -

- Hypertrophic cardiomyopathy
- Arrhythmogenic RV cardiomyopathy
- Long QT syndrome
- Brugada Syndrome

In all these instances the cardiologist must assess whether the patients are at 'high risk' of sudden cardiac death or not. (NB. This is a specialized assessment).

If amounts to low risk, single episode of syncope may not warrant insertion of an ICD. An implantable loop recorder' (ILR) may be more appropriate.

Even in the 'low risk' patients, recurrent syncope (ie. more than 2 episodes) would justify an ICD implantation.

ADVICE REGARDING DRIVING FOR A PATIENT WITH SYNCOPE

- Driving should be prohibited for *6 months* following the last syncopal attack.
- If the syncope has potential for recurrence, driving should be totally prohibited.
- If syncopal attacks have definite prodromal symptoms or has definite gradual onset features, driving may be permitted, after being symptom-free for 6 months.
- If syncopal attacks occur only in the erect posture, driving may be allowed.

6. Neurologic Aspects of Falls

Dr. Champika Gunawardhana

INTRODUCTION

Falls in elderly are often caused by more than one risk factor and commonest among them is neurological disorders. Most of the old age neurological conditions are associated with motor dysfunctions and disturbances in gait and balance which essentially lead to frequent falls.

Recurrent falls are exclusively related to the "intrinsic" features of an individual and more specifically, these can be related to a disorder of either the "base of support" or the "center of body mass". As a result of different disease related dysfunctions, many neurological conditions directly disturb the maintenance of base of support and center of mass. Different neurological phenomena including motor weakness, paralysis, spasticity, ataxia, sensory deficits, dyskinetic movements, coordination and balance disturbances represent common gerontoneurological symptoms.

A recent evidence-based review of the American Academy of Neurology concluded that stroke, dementia and postural instability impairment are level-A risk factors for falling whereas Parkinson disease (PD), neuropathies, lower limbs weakness and poor visual acuity are level-B.

Patients with falls due to neurological illness tend to fall more often and have worse psychological and functional outcomes. Evaluating neurological risk factors in geriatric patients with recurrent falls is therefore essential to establish appropriate prevention strategies.

FALLS IN PARKINSON DISEASE

Falls are frequent among patients with PD as compared to normal elderly population. One cardinal feature of PD is postural instability.

One of the most important risk factors for falls here is the disturbance of center of mass which is specifically related to the postural instability which typically leads to a backward body sway and fall.

The commonest disorder in base of support is, freezing of gait, defined as the episodic inability to generate effective stepping. It occurs most frequently during turning and step initiation. Freezing of gait affects more than 50% of parkinsonian patients and represents a major cause of falls during walking. Particularly, impairment in rhythmicity, symmetry, bi lateral coordination, step scaling and dynamic postural control have been implicated with this. Patients with freezing of gait, usually fall forward because the typical stooped posture of them mechanically favour such direction.

The cognitive profile of patients with parkinsonism may have impairment of executive and attentive functions which also contribute to inability of maintaining stability and mobility.

Parkinsonism is a good paradigm for the understanding of the pathophysiology of falling. Parkinsonian patients display specific features related to falls, such as axial motor symptoms, instability, the impairment of executive functions and the interplay between motion and cognition.

FALLS IN PERIPHERAL NEUROPATHY

Peripheral neuropathy (PN) is common in elderly and results in impairments of distal proprioception and muscle strength that hinder balance and predispose falls.

The predominant reason for impairment of balance in PN is absent or delayed afferent sensory information coming from the lower extremities. These sensory inputs are essential for the continuous micro-adjustments of feet, toes, and ankles to maintain the center of gravity.

The potential increase in fall risk due to PN may be a result of both large fiber and small fiber dysfunction. The symptoms of large fiber neuropathy mainly affect light touch, vibration sense, and proprioception, causing impaired balance and muscle weakness, whereas the small fiber dysfunction affects pain and temperature sensation causing impaired balance and autonomic deficit. One of the clinical features of distal sympathetic small fiber neuropathy is

orthostatic hypotension, which is a common symptom in the elderly and associated with increased risk of fall.

FALLS IN SPINAL CORD DISORDERS

Patients with spinal cord pathologies, who can walk, are at a higher risk of falls. Different spinal cord disorders including cervical myelopathy, spinal cord injury, myelitis and spinal tumors share common neurological characteristics. Cord compression produces progressive spastic paraparesis which is often accompanied by paresthesias and sensory loss. There is a great variation of impairments in this group depending on the extent of cord damage and level of the lesion.

Due to partial or total loss of motor function and sensory input below the level of lesion, most individuals with spinal cord injury experience impaired balance control, which in turn increases the risk of falling. Spinal cord injury related motor weakness and spasticity directly affect gait and that in turn leads to frequent falls.

FALLS IN STROKE

Stroke survivors who can walk are at high risk for falls in all post-stroke stages. There is a great variation of impairments and dysfunctions in stroke patients. Stroke-specific risk factors for falls include reduced lower extremity strength, motor dysfunctions, impaired balance, visual field defects, visuospatial hemineglect, and sensory impairments.

Consequently, stroke patients face significant issues in maintaining balance and gait. Stroke-related balance deficits comprise reduced postural stability during quiet standing and delayed and less coordinated responses in dynamic balance. Gait deficits in stroke include reduced propulsion at push-off, poor knee flexion during the swing phase, and reduced stability during the stance phase. The interplay of coexisting deficits and heterogeneity of dysfunctions make it more difficult to understand the exact pathophysiology of falls in stroke.

FALLS IN MOTOR NEURON DISEASE

Motor Neuron Disease (MND) is characterized by the progressive deterioration of the anterior horn cells of the spinal cord and the corticospinal tracts, causing combination of both lower and upper motor neuron clinical features. Degeneration of the motor neurons leads to weakness and wasting of muscles, a loss of mobility in the limbs and spasticity.

Falls are frequent in the MND population and increase burden of disease. MND patients exhibit poor gait, balance and postural control, all of which significantly increases their risk of falling. The complex interplay of both motor and extra motor manifestations in this disease contribute to the multifactorial causes of such dysfunction and are responsible for reduced gait speed, alteration in gait cycle, as well as structurally more variable and disorganized gait patterns.

FALLS DUE TO FRONTAL LOBE LESIONS

The frontal lobes appear crucial in maintaining gait. According to clinical observations, it contributes to the control of truncal motion, postural responses, and the maintenance of equilibrium. Frontal gait disorders of characteristic gait abnormality are related to different frontal lobe conditions which include vascular disease, Alzheimer's disease, and normal pressure hydrocephalus.

Clinically, these gait disorders can be described as gait apraxia, where the strength, sensation and coordination are intact but the act of "putting it all together" in the brain is problematic. The gait becomes an awkward, magnetic (stuck to the floor), cautious, slow, shuffle. Variable combinations of disequilibrium with a wide stance base, increased body sway, poor control of truncal motion, and gait ignition failure are commonly encountered in diseases of frontal lobes. Related cognitive changes can make them more complex. The pattern of gait may change as the frontal disease progresses.

FALLS IN CEREBELLAR ATAXIA

Ataxic gait refers to a staggering gait, with variability of the step timing and distance between the steps. Ataxic gait disorders mostly occur due to dysfunction of the cerebellum.

Typical causes of ataxia include cerebellar strokes, alcohol intoxication or chronic alcohol abuse, cerebellar degeneration, multiple system atrophy – cerebellar type and multiple sclerosis. Rarer causes include spinocerebellar ataxia which is genetically mediated.

Cerebellar ataxia is characterized by slow progressive incoordination which manifests as problems with balance and gait leading to considerable disability. Patients walk with a variable walking speed and cadence, reduced step length, stride length, swing phase and increased walking base width. This variable interplay of balance, coordination and gait abnormality often relate to increased risk of falls.

FALLS IN MUSCLE DISORDERS

Muscle weakness is consistently associated with falls in the elderly people, typically when present along with other risk factors. The distribution (proximal and distal) and degree of muscle weakness influence the gait and balance control.

Centre of mass displacements is usually greater in patients with distal weakness as it produces unstable trunk, knee and ankle movements whereas the proximal weakness demonstrates only the unstable trunk. Proximal weakness predominantly affects the gait disturbances and difficulties in climbing where it causes greater risk of falls.

FALLS IN VISUAL IMPAIRMENTS

Poor visual contrast sensitivity, reduced visual acuity, defects in visual fields and decreased depth perception as well as environmental factors, including poor lighting, are known to be associated with an increased risk of falls amongst older people.

Reduced visual acuity influences the balance, movement and the strategies used to negotiate the environment. Poor vision affects

stability when stepping up and down and adopting different gaits to avoid obstacles, increasing the risk of trips and falls. Visual field defects, double vision and many other neurological as well as ophthalmological causes of abnormal vision directly affect the maintenance of balance and performance of complex gait.

CONCLUSION

Falls in elderly are mostly multifactorial and commonly related to different neurological dysfunctions. Assessment of falls in elderly population essentially includes an extensive neurological evaluation. Detailed history and clinical assessment are therefore of paramount importance in diagnosing specific underlying neurological pathology. Neuro imaging and other disease specified investigations are essential.

Once the underlying causative neurological condition is established, apart from commencing the disease specific management, it is equally important to emphasize the falls prevention strategies. Understanding the pathophysiology of recurrent falls and the introduction of interventions addressing the deficits will indeed reduce the number of falls in individuals with neurological disorders.

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7. Rheumatology of Stability and Mobility

Dr. Lalith Wijayaratne

INTRODUCTION

There are many musculoskeletal diseases, which affect the bones, joints, muscles and the nerves of lower limbs resulting in disturbance of the stability and mobility in the elderly.

The common musculoskeletal disease that can affect the stability and mobility in the elderly can be classified as follows: -

A. Conditions with involvement of joints of the lower limbs

Eg: Osteoarthritis (OA), Rheumatoid arthritis (RA), Spondyloarthritis (SpA), Gout, Pseudogout

B. Condition with involvement of bone

Eg: Osteoporosis

C. Conditions with involvement of muscles

Eg: Sarcopenia

D. Conditions affecting the neurology of the lower limbs

Eg: Cervical Spondylosis, Lumbar spondylosis, Lumbar spondylolisthesis, DISH (Diffuse idiopathic Skeletal Hyperostosis)

E. Abnormalities of the Foot

Eg: Foot deformities, Foot arch abnormalities, Foot Joint deformities including hallux valgus

F. Drugs used to treat musculoskeletal diseases

NSAIDs – Indomethacin, Analgesics – Tramadol, Gabapentin and Pregabalin, DMARDs – Sulfasalazine

PATHOMECHANISMS

Musculoskeletal diseases can affect the lower limbs through many different mechanisms resulting in abnormalities in gait and increased tendency for fall.

Osteoarthritis (OA)

Osteoarthritis is common in elderly and involves the knees and the hips affecting stability and mobility. Pain in the affected leg joints, weakness of the quadriceps and the muscles around the hips, involvement of the ligaments of the knee, joint deformities and ankylosis (reduction of the range of movements) are some of the reasons for disturbance in gait in OA patients.

Rheumatoid arthritis, Gout and Pseudogout

These inflammatory arthritides affect stability and mobility due to inflammatory pain of the affected joints, weakness of the muscles around the joint, damage to the ligaments and joint deformities.

Osteoporosis

Osteoporosis results in fragility fractures of the spine and hip, which leads to difficulty in mobility.

Sarcopenia

Sarcopenia is associated with reduced muscle mass, power and strength which results in difficulty in transferring and walking. Sarcopenia also contributes to frequent falls.

Cervical spondylosis

Cervical spondylosis may affect mobility by compression of the spinal cord (Cervical Spondylotic Myelopathy) and by involvement of vertebrobasilar artery resulting in dizzy spells. (Vertebrobasilar insufficiency)

Lumbar Spondylosis & Lumbar spondylolisthesis

Lumbar nerve root compression (radiculopathy) and lumbar canal stenosis occur in these conditions.

Abnormalities of the foot

Pain from arches of the feet and joint abnormalities can result in gait disorders affecting stability of patients.

Drugs

May cause dizziness

EVALUATION OF MUSCULOSKELETAL SYSTEM FOR DISORDERS AFFECTING STABILITY AND MOBILITY

Salient features in history

Cervical spondylosis:

Symptoms such as neck pain, stiffness, dizziness especially with neck movements (due to Vertebrobasilar insufficiency), pain and sensory symptoms down the arm and gradual onset stiffness of the legs with walking difficulty (cervical spondylotic myelopathy) indicate involvement of the cervical spine.

Lumbar spondylosis:

Low-back pain and stiffness, pain radiating down the legs, leg pain and/or numbness with walking and standing (neurogenic intermittent claudication) suggest the involvement of the lumbar spine.

Joints of the lower limbs:

Presence of pain and stiffness of the hips, knees, ankles and joints of the feet point to pathology of the large joints of legs. Whereas 'giving way' or buckling and locking of the knee strongly suggest a soft tissue abnormality of the knee, commonly seen in OA.

Sarcopenia:

Slowing down and difficulty in performing almost all physical activities in an emaciated person suggests sarcopenia.

Drug History:

Some of the medications used for the treatment of musculoskeletal diseases can cause dizzy spells, which can affect the stability and mobility.

Examination

A. General Examination

Patient looks wasted and emaciated

B. Spine

Detailed examination of the cervical and lumbar spine needs to be done whilst watching out for tenderness and range of movements.

C. Lower limbs

- a. *Musculoskeletal system* examination should include examination of the hips, knees, ankles and the small joints of feet. One needs to look for joint deformities, alignment, warmth, tenderness of joints, range of movements, crepitation and ligament integrity. Checking for quadriceps weakness or atrophy in OA of knees is important. There could be enthesitis (plantar fasciitis and tendo-achilles tendinitis). Examine patient standing for knee varus and valgus deformities.
- b. Nerves of the lower limbs could be affected as upper motor neuron or lower motor neuron pathologies. Involvement of lumbar nerve roots, femoral and sciatic nerves are possible lower motor neuron pathologies while cervical spondylotic myelopathy is an upper motor neuron pathology. Thus, a thorough neurological examination of lower limbs is warranted.
- c. Examination of the feet should include checking for foot arches, excessive pronation of the foot and forefoot abnormalities such as hallux valgus
- d. Gait should be observed for the presence of a limp, functional limb length discrepancy or buckling.

MANAGEMENT

1. Osteoarthritis

Management of OA includes patient education especially emphasizing the need of regular exercises to strengthen the muscles (quadriceps in knee OA and abductors and extensors of the hip in OA of the hip) and minimizing excess loads on leg joints. The load on the knees and hips can be minimized by weight reduction, avoiding squatting and kneeling, taking adequate rest, avoiding prolonged standing and wearing proper footwear.

Patients with walking difficulty should be referred to a Rheumatology unit for further assessment and treatment. There are no specific drugs for treatment of OA. Specialized treatment for OA of the knee and hip includes- physiotherapy, selection of appropriate assistive devices such

as walking sticks, crutches or frames and provision of correct orthotics. Eg: in knee OA (knee braces) to suit the knee instability. If the patient has symptoms of end stage OA such as the knee or hip pain disturbing ADLs with the presence of night pain, an orthopaedic referral is indicated for joint replacement surgery.

2. Rheumatoid arthritis (RA) and spondylarthritis (SpA)

RA typically presents as a peripheral symmetrical poly arthritis affecting both the upper and lower limb joints. The clinical presentation of spondyloarthritis may include inflammatory low back pain, an asymmetrical arthritis predominantly involving the lower-limb joints associated with enthesitis. Some patients with spondyloarthritis have underlying psoriasis or inflammatory bowel diseases such as Crohn's disease or ulcerative colitis.

All patients with RA and SpA need to be referred to a Rheumatology unit as early as possible. There are many Disease Modifying Anti Rheumatoid Drugs (DMARDs) that can effectively control the inflammation and prevent or minimize the damage caused to the musculoskeletal system as well as minimize comorbidities such as ischaemic heart disease and osteoporosis.

Regular exercises are strongly recommended as all-inflammatory arthritis conditions result in muscle atrophy, which can lead to joint instability and frequent falls.

3. Gout and pseudo gout

Clinical features include sudden onset of severe pain and/or effusion of predominantly the leg joints. Treatment includes use of potent NSAIDs, or colchicine and they need to be referred to a rheumatology unit for specialized management with disease modifying therapy.

4. Sarcopenia

Prevention – All patients suffering from arthritis should be encouraged to do regular exercises to prevent sarcopenia, associated with systemic inflammatory rheumatic disorders. Furthermore, strength training exercises, high protein diet and vitamin D supplementation helps to prevent and minimize sarcopenia.

5. Osteoporosis

One of the most common causes of hip and vertebral fractures is osteoporosis. Therefore, it is mandatory that all elderly (women above 65 and men above 70 years of age) and those who are at risk of developing osteoporosis (History of fracture after the age of 50 years; strong family history of fragility fractures, on long term steroids, patients suffering from inflammatory arthritis, thyroid disorders, premature menopause, thoracic kyphosis deformity) are assessed for their risk of developing a fragility fracture. This can be done by a DEXA scan or applying the country specific (For Sri Lanka) FRAX index. All patients who suffer from osteoporosis needs their Vitamin D status assessed and treated if insufficient or deficient. Bisphosphonates, Parathyroid hormone and denosumab are used to treat osteoporosis. All patients with osteoporosis need Rehabilitation which includes education on fall prevention and exercises to improve strength, flexibility and balance. Rehabilitation also includes provision of canes or walkers and modifying the home with specialized equipment to prevent falls. Weight bearing exercises will facilitate drug therapy to improve bone strength.

6. Cervical and Lumbar spondylosis and DISH

Those affected needs to be referred to a rheumatology unit for specialized management, which includes drugs, physiotherapy and the use of appropriate orthotics such as cervical collars and lumbar supports. Patients with cervical spondyloticmyelopathy, and lumbar spondylosis that are unresponsive to conservative treatment, need surgery.

7. Lumbar spondylolisthesis

These patients need to be managed at a Rheumatology unit with intensive physiotherapy focused on the trunk, hip and lower extremities. Patients with progressive neurologic deficits, evidence of cauda equina compression and persistent and severe leg pain despite aggressive conservative treatment are referred for surgery.

8. Lumbar radiculopathy and Lumbar canal stenosis

Those who have severe radicular pain will benefit from an epidural injection followed by intensive physiotherapy which can be arranged through a Rheumatology or an Orthopaedic unit.

Foot abnormalities

Abnormalities of feet result from abnormalities of soft tissues (Plantar fasciitis, Achilles tendinitis), foot arches (Pes planus and pes cavus) and joints. They cause heel and foot pain. Treatment includes analgesics and the use of proper orthotics such as heel pads and arch supports and metatarsal pads. Those not responding to above measures, needs to be referred to a rheumatology unit for further management.

Hallux valgus when painful is treated with short-term analgesics. Patients need to be educated about footwear- namely shoes with low heels, well cushioned soles, extra depth and broad toe boxes. Those who show a poor response need to be referred to a Rheumatology or an orthopaedic unit. Custom made orthotic appliances to support the foot arches and toe separators placed in the first toe-web helps some patients with hallux valgus.

There are specialized units in the state hospitals and in the private sector in Sri Lanka, which can address foot abnormalities.

8. ENT Perspective of Mobility and Stability among Elderly

Dr Chandra Jayasuriya

Imbalance is a common public health problem in the elderly, with subsequent falls and fractures. Prevention of falls in elderly is essential.

Balance is maintained by vision, proprioception (joint position sense) and vestibular system (inner ear). All these impulses are computed by brain stem and cerebellum. (fig.1) There is progressive impairment of above mentioned systems with increased age, resulting in higher prevalence of falls. The following article tries to give an overview of the Otologic causes that may ensue.

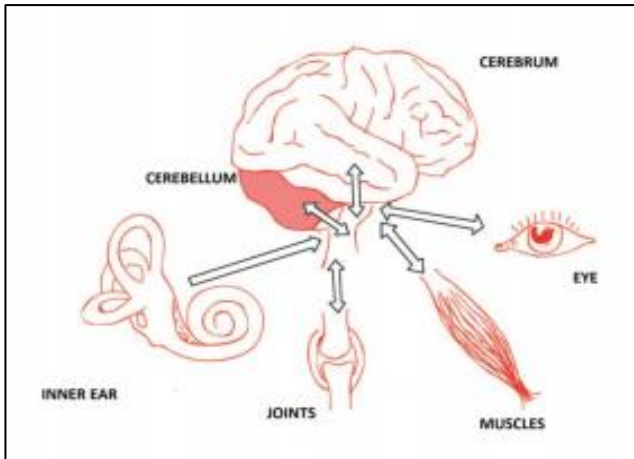


Fig.1 System for maintaining balance

CAUSES FOR INSTABILITY COULD BE CLASSIFIED AS

1. Central - stroke, parkinsonism, epilepsy, migraine
2. Peripheral - peripheral neuropathy, visual impairment, otologic
3. Functional - persistent postural perceptual dizziness
4. Iatrogenic – polypharmacy

Patients with anything ranging from stroke, unilateral vestibulopathy to BPPV (Benign paroxysmal positional vertigo) can present to emergency department. Therefore, it is important to try and differentiate between them in the emergency room setting. In addition to vertigo, stroke patients will have accompanying neurological features such as diplopia, dysarthria, cranial nerve deficits, cerebellar signs, altered gait and positive Romberg's test.

Unilateral vestibulopathy and stroke can be differentiated by a three-step bedside examination protocol "HINTS" examination. Head impulse test is negative in stroke and positive in vestibulopathy. (index)

It is very important to assess vision by an eye surgeon. Correction of cataract on only one side can lead to vertigo due to imbalance of visual input. Therefore, cataract has to be corrected in both eyes, with a short gap of duration between the surgeries of individual eyes.

OTOLOGIC DIZZINESS

Aging: structural changes in vestibular system

- Otoconia - demineralization and fragmentation
- Hair cell loss - 40% in ampullae, 20% in maculae, type 1 more affected than type 11
- Myelinated vestibular nerve fibers - 40% loss
- Scarpa's ganglion - cells decreased
- Vestibular nuclei - lipofuscin, axonal degeneration
- Cerebellum - loss of Purkinje cells, atrophy of vermis

Common causes of Otologic Dizziness in elderly

1. BPPV (Benign paroxysmal positional vertigo)
2. Bilateral vestibulopathy
3. Unilateral vestibulopathy
4. Meniere's disease
5. Vestibular Neuritis
6. Persistent postural perceptual vertigo

The key factor in making a diagnosis of vertigo is a proper history. In more than 95% instances, history itself leads us to the correct diagnosis.

A. Time course

First find out whether vertigo is persistent or episodic. Frequency and the duration of attack is also very important.

- Duration is less than one minute
 - BPPV
- Duration is minutes to hours
 - Meniere's disease
 - Vestibular migraine
- Duration is days to weeks
 - Unilateral vestibulopathy
 - Brainstem CVA
- Persistent for more than three months
 - Bilateral vestibulopathy
 - Functional dizziness
 - Neurodegenerative disorders of basal ganglia and cerebellum.

B. Type of vertigo

One should ask whether there is rotatory feeling or a postural imbalance. Spinning or rotatory vertigo suggests pathology in the semicircular canals or the vestibular pathway. Postural imbalance occurs in bilateral vestibulopathy and functional dizziness.

C. Triggers and aggravating factors

Head position related to gravity in BPPV, certain social situation in functional dizziness, aggravating during daytime in persistent postural perceptual dizziness or during night time in bilateral vestibulopathy.

D. Accompanying symptoms

Deafness, ear fullness and tinnitus are seen in Meniere's disease. Headache and hypersensitivity to sound, light and motion are seen in migraine.

BPPV (BENIGN PAROXYSMAL POSITIONAL VERTIGO)

Nearly 50% of dizziness in elderly (more than 75 years of age) is caused by BPPV. Patients complain of brief bouts of vertigo (lasting few seconds), provoked by change of head position related to gravity.

Pathophysiology

It is caused by otoconial debris moving inside the semicircular canals. Otoconia are CaCO_3 crystals, normally found in the utricle and saccule (attached to the otolithic membrane). When these otoconia are freed, they enter the lumen of semicircular canals and stay afloat. When head is rotated relative to gravity, stimulation of the semicircular canal sensory epithelium causes vertigo.

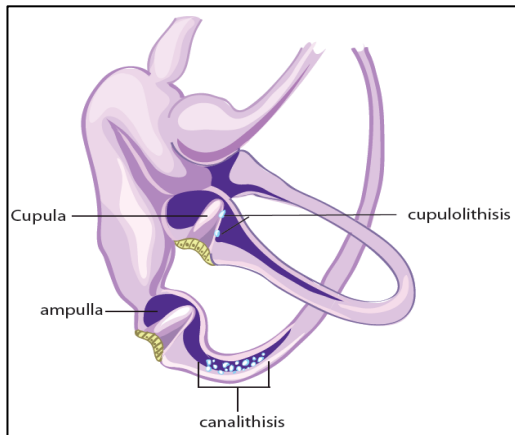


Fig.2 Pathophysiology of BPPV

Diagnosis

This condition is diagnosed by Dix Hallpike test. (fig.3) No special investigation is necessary to diagnose. During the test, vertigo and nystagmus occur after a short period of latency and then increases, decreases and resolves within 60 seconds of onset.

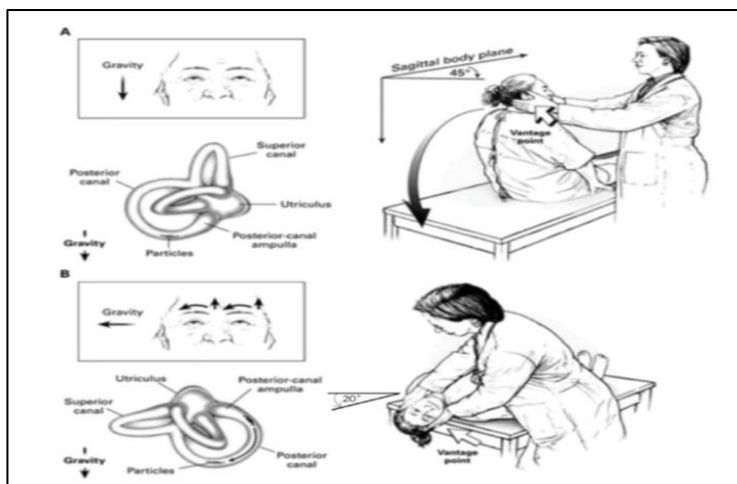


Fig.3 Dix Hallpike test

Treatment

If Dix Hallpike test is positive, otoconia repositioning into the utricle can be done by special maneuvers. Such as Epley maneuver(fig.4) and Sermont maneuver. Most patients immediately respond to the maneuvers. In fact, they are very grateful. BPPV patients can have residual symptoms after the maneuvers. Brandt-Daroff(fig.5) home exercises are demonstrated and these can be done twice a day for 2-3 weeks.

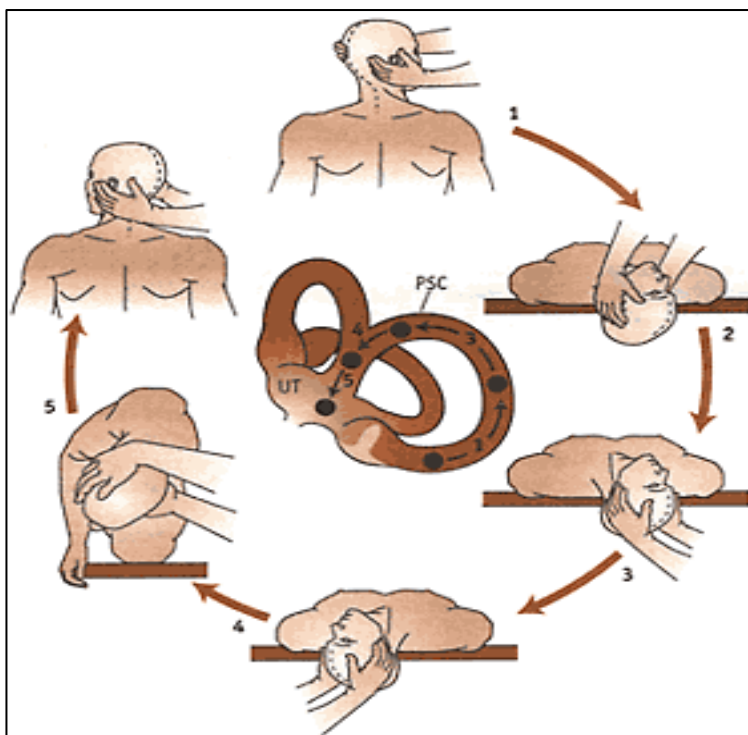


Fig.4 Epley maneuver

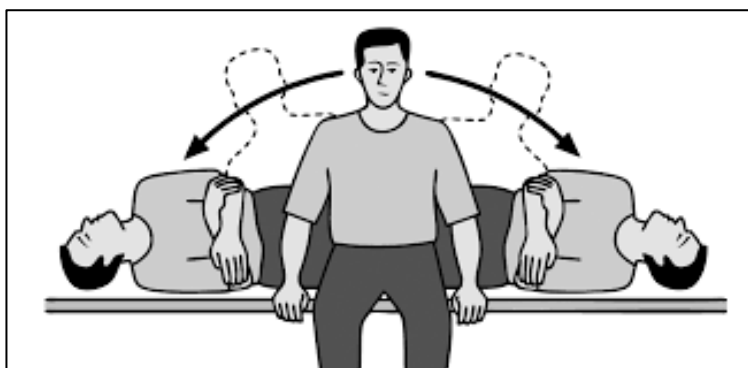


Fig.5 Brandt-Daroff maneuver

BILATERAL VESTIBULOPATHY

This is characterized by unsteadiness and oscillopsia (visual field appears to jump) during rapid head movements.

Pathophysiology

Majority are idiopathic. Most frequently identified cause is aminoglycoside toxicity (eg. gentamycin, streptomycin). Even a single dose, especially in the background of renal impairment may be toxic. It may also follow meningitis, vestibular neuritis, skull base trauma, autoimmune ear disease and long-standing Meniere's disease affecting both ears.

Diagnosis

Video oculography can be done to confirm the diagnosis.

Treatment

Vestibular rehabilitation therapy (VRT) is the most useful form of treatment.

MENIERE'S DISEASE

This patient presents with episodic vertigo associated with unilateral hearing impairment, tinnitus and fullness of the ear. However, in the elderly, presentation may be atypical. It can progress to bilateral irreversible hearing loss and 0.5% of patients with Meniere's disease get drop attacks (sudden fall without loss of consciousness).

Pathophysiology

Endolymphatic hydrops is caused by excessive production or reduced resorption of endolymph.

Diagnostic criteria

- 2 or more attacks of vertigo
- Hearing loss at least on 1 occasion
- Tinnitus
- Ear fullness
- Other causes excluded

Investigations

- Pure tone audiogram- low frequency hearing loss
- High definition MRI scan-to exclude other central causes of vertigo.

Treatment

For acute episodes' vestibular suppressants and antiemetics are used, whereas long term management is with diuretics and steroids. Invasive techniques would be intratympanic injections of dexamethasone in initial stages and gentamycin for later stages. Surgical intervention is recommended only for incapacitating vertigo. As prophylactic treatment salt restriction, diuretics and betahistine are used.

VESTIBULAR NEURITIS

It is an acute, self-limiting condition which presents with vertigo, nausea, ataxia and nystagmus. Acute episode is managed with antiemetics. Although this is not specific to the elderly, they may not recover as quickly as younger patients and may benefit from vestibular rehabilitation therapy (VRT).

Pathophysiology

This is attributed to a viral infection of the vestibular nerve (*Herpes simplex* or *Varicella zoster* viruses). there is resting activity of hair cells of both labyrinths. As right and left labyrinths are mirror image of each other, resting activity is cancelled. If one vestibule is not working, resting activity of the healthy labyrinth causes vertigo due to mismatch input.

Investigation

Diagnosis is clinical.

Treatment

Acute episode is managed with antiemetics. This may benefit from VRT.

PERSISTENT POSTURAL PERCEPTUAL DIZZINESS

This is considered a chronic functional disorder of the nervous system.

Precipitated by episode of vertigo or unsteadiness of

- Vestibular origin
- Neurological origin
- Psychiatric origin

Patients often develop secondary functional gait disorder with

- Anxiety
- Avoidance behavior
- Severe disability

Patients often present with chronic, vague symptoms.

- Heavy/light headedness
- Tightness in the head
- Floor rising falling

PPPD may coexist with other known vestibular disease (Meniere's disease, BPPV)

Diagnosis

Physical examination followed by laboratory testing to exclude other causes. Vestibular evaluation in a vestibular lab and imaging to exclude other causes.

Treatment

Multi-disciplinary approach of ENT surgeon, neurologist and psychiatrist is necessary.

Cognitive behavioral therapy is the most promising, emerging treatment and VRT also indicated.

VESTIBULAR REHABILITATION THERAPY

VRT is a form of physical therapy which uses specialized exercises to enhance nature's compensatory mechanism. VRT relieves symptoms

and helps the patient to return to ADLs early. This is not useful during the acute phase of condition.

Goals of VRT

- Enhance gaze stability
- Enhance postural stability
- Improve vertigo and ADLs

Components of VRT

- Coordinating eye and head movements
- Stimulating the symptoms of dizziness in order to desensitize the vestibular system.
- Improving balance, walking ability, fitness and endurance

How confident are you that you will not lose balance or become unsteady when you...?

(No Confidence 0% 10 20 30 40 50 60 70 80 90 100% Complete Confidence)

1. walk around the house?
2. walk up or down stairs?
3. bend over and pick up a slipper from the front of a closet floor?
4. reach for a small can off a shelf at eye level?
5. stand on your tiptoes and reach for something above your head?
6. stand on a chair and reach for something?
7. sweep the floor?
8. walk outside the house to a car parked in the driveway?
9. get into or out of a car?
10. walk across a parking lot to the mall?
11. walk up or down a ramp?
12. walk in a crowded mall where people rapidly walk past you?
13. are bumped into by people as you walk through the mall?
14. step onto or off an escalator while you are holding onto a railing?
15. step onto or off an escalator while you are holding onto parcels?
16. cannot hold onto the railing?

HIT

HIT is the most effective method for detecting loss of vestibular function at the bedside. For HIT, the examiner asks the patient to fixate on a target in front of the eyes and briskly turns the patient's head horizontally. If the vestibulo-ocular reflex is working normally, HIT will generate a compensatory eye movement in the opposite direction of the head rotation with equal amplitude, holding the gaze steady. In contrast, HIT toward the side of a peripheral vestibular lesion will give rise to a re-fixation catch-up saccade at the end of head motion to bring the image of the target back to the fovea. This corrective saccade (overt saccade) indicates a decreased vestibulo-ocular reflex in patients with peripheral vestibular deficits. While an overt saccade is observed in most patients with acute peripheral vestibular disorders, HIT is usually normal in central vestibular lesions. Thus, one should suspect a central pathology if a patient with acute vertigo and spontaneous nystagmus exhibits normal HIT. A refixation saccade in a different plane (i.e., vertical catch-up saccade after horizontal rotation) also suggests a central lesion. However, bedside HIT may be negative when the vestibular deficits are partial, or the covert saccades complement the vestibular deficits.

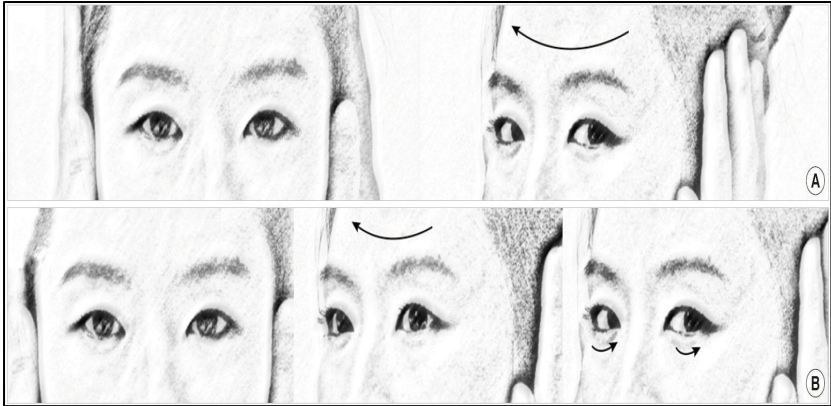


Fig.6 Head impulse test (HIT). (A) In healthy subjects, HIT (arrow) normally induces a rapid compensatory eye movement in the opposite direction, and steady fixation is attained. (B) In patients with unilateral peripheral vestibular hypofunction, HIT toward the affected side (large arrow) produces a corrective saccade (small arrows) after head rotation because the eyes move with the head due to a defective vestibulo-ocular reflex, thus losing the target with head rotation.

OCULAR MISALIGNMENT

Ocular misalignment occurs frequently in central vestibulopathies and should be determined in nine cardinal gaze positions along with limitations in the range of eye movements. Skew deviation refers to vertical ocular misalignment resulting from vestibular tone imbalance. The presence of skew deviation may be inferred by vertical diplopia and can be confirmed with the cover test(fig.7).

With one eye covered, a corrective vertical movement of the opposite eye to fixate on a target indicates the presence of skew deviation. Skew deviation may occur in any acute lesion involving the posterior fossa, but most cases are seen in association with brainstem stroke. Skew deviation is typically observed as a component of the ocular tilt reaction (OTR) that includes head tilt, ocular torsion, and skew deviation(fig.8). As a rule, the head is tilted toward the side of the lower eye and the ocular torsion occurs in the same direction with the upper poles of the

eyes rotating toward the lower eye. Lesions below the lower pons cause ipsiversive OTR, while more rostral lesions induce contraversive OTR.



Fig.7 Cover Test

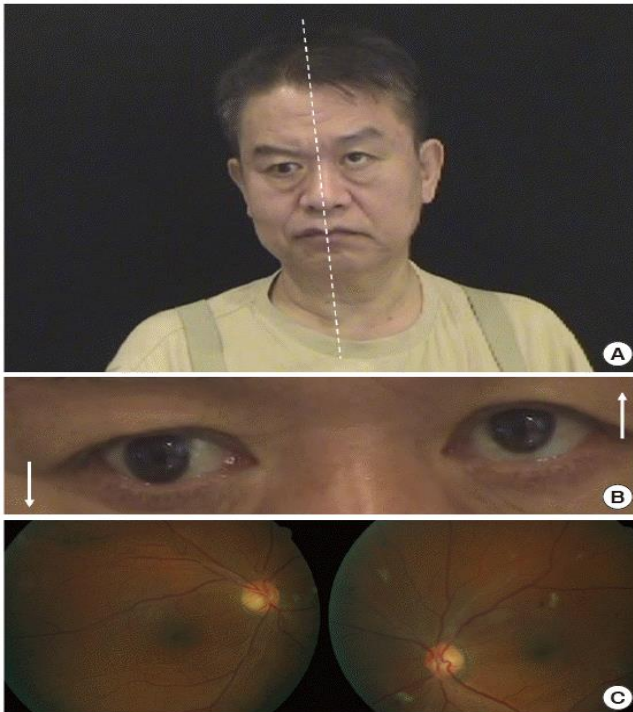


Fig.8 Ocular tilt reaction. The ocular tilt reaction refers to (A) head tilt, (B) skew deviation, and (C) ocular torsion ascribed to imbalance in the otolithic inputs from the utricles on both sides. The head tilt and ocular torsion occur toward the hypotropic eye. Informed consent was received from the patient.

9. Mood and Cognitive Causes affecting Stability and Mobility in Elders

Dr. Malsha Gunathilake & Dr. Kapila Ranasinghe

Stability and mobility are key factors for successful aging in older adults. They are crucial for an individual to carry out basic activities of daily living (ADLs) as well as to make use of health care facilities, keep up social relations, and to take part in community life. Old age certainly has a negative impact on stability and mobility mainly owing to physical frailty. However, psychiatric conditions especially depression, anxiety and cognitive disorders also have a huge impact on it.

Positive mood has been recognized as a facilitating factor for activity and engagement in old age for a long time. On the other hand, negative mood status has detrimental effect on mobility and activities. Out of all mood disorders, depression is the commonest in the geriatric population. Nearly 20-40% of older adults suffer from depression. This prevalence is higher in presence of significant medical illness. Depression significantly contributes to an individual's disability and functional decline. Specifically, it has been noted to decrease the standing balance, walking speed, the ability to rise from a chair, and function in ADLs. Lower levels of physical performance are strongly predictive of institutionalization which further leads to immobility and disability. Depression is also frequently associated with medical illnesses which anyway cause disabilities such as stroke, Parkinson's disease and arthritis. This co-existence worsens the overall disability further. The main features of depression; low mood and diminished pleasure lead to lack of interest in mobilizing, leading to social isolation. Other symptoms of depression, such as weight loss, sleep disturbances, and fatigability also contribute to unsteadiness and immobility. Patients with severe depression who refuse food may end up in severe malnourished state if left untreated. It will cause physical disabilities which minimize the mobility and stability. Therefore, the early diagnosis and proper management of depression can help to decrease further disability and restore function.

When diagnosing depression in old age it is important to note that depression in the geriatric population may differ from that of general population in some ways. Elderly people with depression are more likely to present with somatic complaints, to minimize their depressed mood (masked depression), and to hide their feelings of guilt. Hypochondriasis (believing having a major illness) also occurs in 65% of the elderly population with depression. Depression is a treatable entity. There are effective modes of treatments including medications (antidepressants), psychotherapy and Electro Convulsive Therapy which are proven to be safe in old age. It is also important to screen those with medical illnesses that are known to be associated with depression in early stages and treat them. It will facilitate the process of rehabilitation. The earlier the intervention is the better the outcome is likely to be.

Anxiety disorders, once thought to be rare in geriatric patients, are now known to be common. They may affect 10-20 percent of the older population, though often undiagnosed. Women are affected more than men. Commonly, fears about aging can lead to anxiety. Many older adults are afraid of falls, failing to afford living expenses and medication, being victimized, dependency, isolation and death. Generalized anxiety disorder is the commonest type. However other types including simple phobias, panic disorders, agoraphobia are also seen in among them. Anxiety disorders themselves minimize patients' mobility as their outings are limited as safety measures. Even though it is not up to the level of a disorder, presence of anxiety symptoms especially the fear of falls themselves limit individual's mobility. Anxiety disorders are successfully treated with cognitive behavioural therapy and medications (SSRI, SNRI).

Cognitive functions are crucial for independent living and mobility. Mild cognitive impairment, dementia and delirium are disorders of old age associated with cognitive deficits. In these cases, subsequent impairment of executive functioning impacts the patient's mobility and ADLs. Dementia is a disorder that shows decline in one or more cognitive domains including memory, language, visuo-spatial, attention and executive function, severe enough to impair the daily living. There

are different types of dementias. Alzheimer's disease(AD)is the commonest (60-70%) Followed by Vascular dementia(VaD) (15-25%). Fronto temporal dementia(FTD), Lewy Body Dementia (LBD) and Dementia of Parkinson's disease(PD) are among the other common causes. VaD, LBD, PD are associated with disabling motor symptoms in their early stages which has negative impact on mobility and lead to falls. AD at its later stages causes immobility. Physical exercises and correct physiotherapy may help to maintain stability and mobility in this group for some extend. Sometimes drugs used to manage the behavioural and psychological symptoms of dementia such as antipsychotics and sedatives can lead to drowsiness, loss of stability and falls. These patients are also liable to extrapyramidal side effects with antipsychotics. Therefore, careful use of medication is also important in these patients to maintain their mobility.

Delirium is a disorder characterized by fluctuating level of consciousness and pervasive impairment in mental, behavioral, and emotional functioning. It is usually of acute onset and is temporary. Delirium is frequently caused by physical disease or drug effects. Two sub types of delirium are described; hypoactive and hyperactive. n hypoactive variant, level of psychomotor activity is diminished. Delirium leads to prolonged hospitalization and impaired physical function. Deconditioning, immobility, decline in ADL and IADL functioning and social isolation are identified as other consequences of delirium in old age patients. Early identification and treatment of the cause may lead to better outcome.

Therefore, early identification and treatment for the psychiatric disorders is of utmost importance as much as treating physical causes to maintain stability and mobility in older adults.

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10. Metabolic and Infectious causes affecting the Mobility & Stability in the Elderly

Dr. Manilka Sumanatilleke & Dr. Panduka Karunanayake

THE EFFECT OF AGEING ON HEALTH AND DISEASE IN RELATION TO MOBILITY AND STABILITY

Ageing is recognized to affect several tissues and organs that are important for stability, even in persons who are apparently well. Gradual neuronal loss, anterior horn cell loss and loss of type II muscle fibers, poor nutrition and reduced activity all contribute to gradual muscle weakness and wasting, or **sarcopenia**. Changes in the eyes (especially lens and macula) may lead to **visual impairment**. Gradual dorsal column loss may lead to **impaired sensation**. All these produce an element of instability that is part of ageing even in those who are apparently healthy. Importantly, while cochlear function deteriorates with ageing leading to impaired hearing, vestibular function does not deteriorate in 'healthy' ageing.

Another important concept in this regard is **frailty**, which is described as an increased vulnerability to stresses. Those with greater frailty will respond poorly to stress, with more significant illness, organ-specific complications, and more incomplete and protracted recovery. Frailty can be measured using scoring systems such as the **Fried Frailty score** and the **Rockwood score**.

These are further compounded by disease states, especially **co-morbidities**, which can also lead to **polypharmacy**. Both polypharmacy and reduced organ reserve that is seen in the elderly, make adverse drug reactions commoner and more severe. Acute diseases, such as stroke or acute myocardial infarction, may also leave behind **functional deficiencies**, which also contribute to further loss of stability.

It is on this general background that one must consider specific causes of loss of mobility and stability. While specific, individual causes of loss of mobility and stability are clearly important and must be identified and corrected as far as possible, it is important to bear in mind the great

variation in frailty or functional reserve, previous co-morbidities and medications, as well as the effects of 'healthy' ageing itself in evaluating an elderly patient with loss of mobility and stability. This overall evaluation is apt to be missed in our hospital setting, where service delivery is designed according to the doctor's line of specialization rather than the patient's need and there is lack of overall assessment and management. For instance, in an elderly patient recovering from an acute myocardial infarction, a lot of emphasis may be placed on expensive and risky procedures for the revascularization of blocked coronary arteries, but more benefit may come from strategies that are aimed at improving muscle strength and coordination such as nutrition, physiotherapy and improving lung function which are less costly and less risky.

There are many metabolic origins which can contribute to loss of stability and mobility among elderly. Early recognition of such conditions will only require simple remedial measures mostly. Commonly encountered such conditions are discussed below.

DIABETES MELLITUS

Diabetes is very common in the elderly and in multiple ways it could affect their mobility and stability.

Hyperglycaemia per se can cause dizziness and unsteadiness but the effect of **hypoglycaemia** would be much more profound in this aspect. Elderly are more prone for hypoglycaemia with diabetic medications especially older generation Sulphonylureas and Insulin. Choosing regimes with less hypoglycaemic potential and proper advice on small frequent meals could mitigate this risk.

Chronic complications of diabetes are major contributory factors. Diabetic neuropathy is a leading cause of instability of gait in the elderly. **Sensori-motor peripheral neuropathy** causing a 'glove and stocking' sensory impairment is by far the commonest presentation, but **diabetic autonomic neuropathy** is an often-unrecognized entity which can have a devastating effect on mobility and the stability of an elderly diabetic.

Loss of touch, pressure and proprioceptive sensations occur with long standing peripheral neuropathy (PN). Motor neuropathy may cause the loss of foot arches, clawing of toes and hammer toes. All these will affect the 'foot mechanics' increasing the risk of falls.

Postural hypotension due to autonomic neuropathy can cause significant morbidity in the elderly with the severe presentations confining them to bed. Certain physical measures, low dose Fludrocortisone or in extreme cases Midodrine help in the management. Many medications given for diabetes (eg: SGLT2 inhibitors) also can contribute to postural hypotension.

The role of '**Diabetic foot**' with toe or forefoot amputations causing instability will not need further explanation. **Peripheral vascular disease** also contributes to the burden of diabetic foot disease.

Diabetic retinopathy causing visual impairment too can be a cause for increased falls in the elderly.

HYPOTHYROIDISM

Primary hypothyroidism is the second most common Endocrine disease in the elderly. Its prevalence increases with age and it is commoner among elderly females to a ratio of about 9:1. Overt Hypothyroidism can affect the mobility and stability of the elderly in many ways although evidence is lacking to say that subclinical hypothyroidism will do the same.

Commonest mechanism of instability in the hypothyroid elderly would be the **proximal myopathy**. Muscle pain and cramps associated with high CPK levels would add to the disability. **Sarcopenia** which shows a causal relationship with low thyroid hormone levels can also contribute.

Severe hypothyroidism can cause **cerebellar symptoms** which are a major cause of instability and falls. **Hyponatremia** is seen in hypothyroidism not so infrequently. Although it's often mild it can contribute for falls by causing or aggravating postural hypotension and muscle weakness. **Increased sleepiness, impaired cognition and urinary incontinence associated with constipation** are well

recognized entities associated with hypothyroidism that can increase the risk of falls indirectly.

HYPERTHYROIDISM

Hyperthyroidism is less common in the elderly compared to hypothyroidism but can be missed due to atypical presentations.

Myopathy and **hyperthyroid periodic paralysis** associated with hypokalemia are entities that can cause severe weakness and falls.

Osteoporosis is commonly caused or aggravated by hyperthyroidism in the elderly: significance of this entity is discussed elsewhere.

Tremor and **cardiac arrhythmias** associated with hyperthyroidism can also be causative for falls.

OBESITY

Obesity in geriatric population is an important factor that can have an impact on their quality of life, activities of daily living, mobility and stability. Although the prevalence of obesity among the elderly is comparatively less considering the 'pandemic proportions' seen in younger groups, still it is gradually increasing world- wide.

Obesity is unique in the elderly with the commonly used measure of Body Mass Index (BMI) being not so accurate of the true metabolic status. Sarcopenia which occurs in the elderly will encourage increased deposition of fat in the muscle in those who have a nutritional excess. In the elderly there is also a tendency of body fat to redistribute to the abdomen.

Hence estimation of total body fat (by MRI or DXA) and the Waist hip ratio will give a better idea about the degree of obesity.

With this background, the effect of obesity on mobility and stability will be directly due to **mechanical reasons** and indirectly due to **Osteoarthritis, pain** and muscle weakness associated with **Sarcopenia** and other reasons discussed above.

Obesity is associated with reduced postural control and stability that could hinder the ability to adapt to changes in terrain during walking. Patients with obesity are at high risk for mobility disability due to a combination of musculoskeletal, neurological, cognitive, personal and environmental factors.

Another important point is certain **medications** in the elderly can contribute to the weight gain and instability (eg. Insulin, Thiazolidenediones, Tricyclics, SSRI's, Beta blockers etc)

Attempt to lose weight through nutritional measures should be done very carefully as nutritional deficiencies can also increase the risk of falls due to muscle weakness and the risk of osteoporosis increases.

VITAMIN B₁₂ DEFICIENCY

Vitamin B12 deficiency is another important factor which has a direct effect on the mobility and stability in the elderly. Prevalence in the elderly is up to 25% in certain studies done in the western world. Main causes identified are decreased gastric acidity (mainly caused by PPI's), certain drugs like Metformin and nutritional (vegetarians.)

Impact of B12 deficiency on nervous system (demyelination) is well established and this can vary from **PN to Subacute combined cord degeneration**. Neuropsychiatric symptoms may also present impairing cognition. Vitamin B12 deficiency commonly present with loss of vibration and/or position sense, ataxic gait, reduced sensation with a sensory level, positive Romberg's test and muscle weakness. These are obvious risk factors for impaired mobility and stability.

Postural hypotension and **Pernicious anaemia** are other consequences of B12 deficiency and they can have an impact on the mobility and the stability of an elderly person especially with other co-morbidities.

OTHER

Other metabolic disorders that can compromise stability include PNs due to conditions such as chronic kidney disease. It produces a distal symmetrical axonal polyneuropathy, starting with numbness and

tingling, and progressing to muscle atrophy, weakness, cramps and restless leg syndrome. The progression may be halted by chronic haemodialysis and is best managed through renal transplantation.

Distal symmetrical PN (of the demyelinating type) is also seen in multiple myeloma and other plasma cell dyscrasias as well as due to its newer treatments, with thalidomide and bortezomib (affecting small nerve fibers).

INFECTIOUS DISEASES IN MOBILITY AND STABILITY

The specific infectious diseases that specifically affect the neurological (including vestibular), musculoskeletal or other components important in stability are few. But the *non-specific* effect of an infectious disease on an elderly patient's mobility and stability is great. Any infectious disease can produce systemic effects that are severe enough to destabilize an elderly patient. These include the common infections in the elderly, including respiratory tract infection (influenza, pneumonia), urinary tract infections (acute pyelonephritis, acute prostatitis, acute epididymo-orchitis), cellulitis, and infections in indwelling devices or prosthesis. Infections such as acute appendicitis, acute diverticulitis, acute septic arthritis, and periodontal infection are less common but easily missed. In this regard, the bigger challenge is to recognize that an infectious disease is the primary (or sometimes a secondary) culprit producing the instability, rather than to identify a specific infectious disease causing instability. It is also important to realize that the elderly may often present in sepsis without any fever; may present with false-localizing features such as confusion, diarrhea or urine incontinence; as well as non-specific general features such as going 'off-feet' (e.g., not coming out of the room), 'off-color' (e.g., losing the usual interactions with family members) or 'off-food' (leading also to dehydration). Furthermore, chronic disease (including chronic infections such as tuberculosis, HIV infection) can produce significant cachexia, muscle wasting and instability.

The rarer, specific infections causing impairment in neurological and musculoskeletal function include the causes of PN and joint malfunction. Peripheral neuropathy is a feature of syphilis, which is now rare, and HIV infection. About one-third of HIV infected patients develop a predominantly sensory, axonal-type PN that responds poorly to anti-retroviral therapy. HIV infection as well as several other infections can cause the Guillain-Barre syndrome, which produces an acute or subacute PN. Overall, however, neurological symptoms in relation to infections are commonly the result of side effects of antimicrobials (e.g., isoniazid, metronidazole, fluoroquinolones, nitrofurantoin, linezolid, griseofulvin). Several anti-retroviral drugs (nucleoside-analog reverse transcriptase inhibitors or NRTIs) and anti-tuberculosis drugs (especially isoniazid, rarely ethambutol) also cause PN. Some antibiotics may worsen myasthenia gravis causing muscle weakness (fluoroquinolones and macrolides). Aminoglycoside antibiotics can cause direct vestibular injury, while typhus rarely produces encephalopathy and inner ear disease (mainly deafness). Musculoskeletal conditions that impair stability include septic arthritis, which can present with little or no symptoms relating to the affecting joint itself, as well as side effects of fluoroquinolones, which can affect nerves, muscle and tendons.

11. Pharmacotherapy and Falls

Dr. Vathulan Sujanitha

A fall is defined as an event when a person comes to rest unintentionally on the ground or other lower level, without any extrinsic force. The etiology of falls is diverse and both environmental factors and disease related factors play important roles. Falls among elders are very common which often end up with devastating consequences causing tremendous amount of morbidity, mortality and hospitalization. In addition to causing serious injuries, falls can result in morbid fear of falls in the elderly.

With changing demographics and increase in elderly population, multimorbidity has become an important public health issue globally. Multimorbidity leads to higher treatment burden and polypharmacy which in turn leads to high incidence of falls. Polypharmacy means use of multiple medications by a patient, with varying numbers, generally ranging from 5 to 10.

Medication use is one of the most modifiable risk factors for falls and understanding the mechanisms by which the medications increase the risk of falls will help to reduce the incidence of falls.

COMMON DRUGS ASSOCIATED WITH FALLS

In connection with pharmacotherapy, there are some groups of medications that increase the risk of falls. These include but not limited to psychotropic medications such as antipsychotics, sedatives, hypnotics, anxiolytics, antidepressants; Analgesics such as NSAIDs, opioids, antiepileptics, anti-Parkinson medications, cardiac medications such as antihypertensives, anti-arrhythmics, anticoagulants, diuretics, anti-diabetics and laxatives.

Some drugs cause sedation, confusion and orthostatic hypotension which is directly linked with falls. They also can cause altered gait and balance, muscle weakness, peripheral neuropathy and change in frequency and urgency of urination. By these mechanisms either alone or in combination, they cause increased incidence of falls. The risks

increase exponentially with the number of medications. However, it is yet to be established whether the risk of falls related to many drugs occurs only during drug initiation or is seen with stable chronic use.

Many elderly people are on multiple unnecessary drugs in higher doses than recommended. As the number of medications rise, the chances of potential drug interactions and the risk of falls also rise. In addition to specific drug types, greater numbers of medications of any class and recent changes in the dose of any medication are associated with increased fall risk.

INAPPROPRIATE MEDICATION USE

Several medications have been classified as inappropriate to use in majority of older patients due to their unacceptable side effects. The table below shows common classes of medications and their adverse effects which may cause increased incidence of falls.

Class of medication	Examples	Adverse effect resulting in fall
Benzodiazepines	diazepam	sedation
	lorazepam	cognitive impairment
	chlordiazepoxide	
Anticholinergics		
Tricyclic antidepressants	amitriptyline	Sedation
	Oxybutynin	
Parkinson medications	levodopa	Postural Hypotension Cognitive impairment
Cardiovascular medications	methyldopa	Orthostatic hypotension Electrolyte disturbances
	doxazocin	
	nifedipine	
	ACEI/ARB	
Others	chlorpheniramine	Confusion
	cimetidine	Sedation

Antihypertensive medications

Selection of antihypertensive medications needs to be done very carefully as many drugs can cause first dose hypotension. This is worsened by combination of antihypertensives. Further, they cause electrolyte imbalances specially hyponatraemia, hypokalaemia and hyperkalaemia increasing the risk of falls. In fact, it is shown that antihypertensive medications do not improve mortality in very frail people probably due to increasing risk of falls.

Sedatives

These drugs increase risk of falls due to functional decline, cognitive impairment and sedation and cause increased fracture related mortality. Sometimes, drugs used to treat insomnia, temporarily prescribed during a hospital stay may be continued inadvertently after the discharge and lead to long term dependency and increased risks of falls.

Anticholinergics

The use of anticholinergic drugs needs to be minimized in frail elderly people. Many drugs such as tricyclic antidepressants, drugs used in parkinsonism (Ex: Benhexol) can increase the anticholinergic burden of the elderly. Anticholinergic effects such as sedation, cognitive impairment, delirium, arrhythmia and orthostatic hypotension all cumulatively result in increased risk of falls.

Antipsychotics

This group of drugs is highly associated with increased risk of falls. They cause increased risk of falls by causing sedation, postural hypotension, extra pyramidal motor symptoms and cognitive impairment. Unfortunately, these drugs are seen prescribed perhaps little too liberally in elderly. Their indication, route and dose of administration need strict monitoring.

Polypharmacy

Polypharmacy (i.e. taking too many pills for chronic diseases) and frailty are very common among elders. Often, in order to alleviate side effects of current medications more drugs are being prescribed and this leads

to the vicious cycle of 'prescribing cascade' which cause more adverse effects and more falls.

There is enough evidence that reducing the use of psychotropic drugs and reducing polypharmacy burden overall can lead to reduction in falls and cognitive impairment.

PHARMACOTHERAPY EVALUATION

A detailed past medical history and medication lists will contribute immensely in finding the causative agents in falls. Medication reviews can be done as periodically or annually or in response to an acute illness. Each clinician should look for opportunities to de-prescribe medications that carry greater falls risk. A reasonable balance between polypharmacy and inappropriate under-prescription considering individual patient characteristics and preferences needs to be achieved.

When prescribing, each clinician should consider following factors.

1. The risks Vs benefits of all medications in an individual
Eg. Antihypertensives may reduce the risk of stroke but may also increase the risk of neck of femur fractures. Both may cause high mortality.
2. Sedatives such as benzodiazepines and neuroleptics need frequent dose reductions and shortest possible durations. They should be discontinued whenever possible.
3. Regular reviews of medications in hospitalized patients will reduce in hospital risk of falls.

When reviewing a patient's medications, always consider the following factors.

1. Agents without a clear benefit should be withdrawn
2. Medication adherence of necessary medications
3. Is the drug still indicated?
4. Appropriate /inappropriate medication?
5. Drug-drug interaction
6. Drug-disease interaction

7. Antagonizing medications
8. Co prescription of same class of drugs
9. Prescription cascade
10. Inappropriate dose or formulations
11. Polypharmacy
12. Inappropriate under prescription

Potential culprit medications checklist in falls risk assessment tool will help to achieve this avoidance of polypharmacy and risks of falls. Multidisciplinary approach with primary care physicians, specialists and pharmacists when prescribing in elderly is essential. Multifactorial intervention programs for elders with risk of falls should include frequent review of medications which will reduce the incidence of falls. Elder patients should also be asked about alternative medical therapies especially herbal medication and over the counter medications to see the actual amount and number of medications they are taking.

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12. Geriatric Patient and Alcohol Use Disorders

Dr. Jayamal De Silva

Alcohol and tobacco are the two commonest substances used by the elderly men in Sri Lanka. As with other age groups it appears that approximately 40% of elderly men use alcohol though the use lessens with ageing. The consumption is highest among the least educated and most disadvantaged men. Alcohol is an important cause for falls and restricted mobility in this age group. Alcohol use among the elderly, poses unique problems when it comes to diagnosis, management, long term care and prevention and prevention needs a broad perspective.

Alcohol use among the elderly can give rise to problems including falls, confusion, amnesia, alcoholic dementia, drug interactions, alcoholic liver disease, gastritis etc. Alcohol complicates the presentation in a delirious patient who has other medical conditions. High index of suspicion for Alcohol usage is warranted prior arriving at conclusions as some of the elderly patients tend to conceal their consumption even from the family.

Sensitivity to effects of alcohol and resultant bodily and brain damage increases with ageing. The same amount of alcohol in an elderly patient would result in much more sedation, confusion and incoordination compared to a middle-aged person. Sensory impairment including peripheral neuropathy, cerebellar and cerebral damage leads to gait instabilities and falls.

FALLS AND ALCOHOL

Falls from alcohol could be due to several factors. They include: Intoxication, withdrawal, seizures, muscle weakness, cognitive impairment, poor coordination, sensory impairment and sleep pattern alteration.

Medical and surgical patients need to be screened for possible alcohol withdrawal especially if they become agitated on the second or third day of admission as delirium tremens could well be the cause. It is important to remember that most patients would not be able to tell or

choose not to talk about their alcohol use. Likewise, “unexplained” repeated falls should alarm a clinician to the use of alcohol by a patient.

DIAGNOSIS OF ALCOHOL USE DISORDERS

The diagnosis might be difficult due to deliberate concealment of the amount taken. A collateral history is of paramount importance here and laboratory investigations including liver functions, full blood count and ultrasound scan of the abdomen are essential components of a complete evaluation. CAGE questionnaire could be used for screening at an outpatient or general practice setting, for the people who might have an alcohol related problem. It is also important to know exact diagnostic categories (ex: Intoxication, withdrawal, Alcoholic psychosis, dementia and amnesic syndromes) when dealing with such patients because casual usage of such terms may indicate a different meaning, medically.

More than the specific diagnosis, the severity of use and the problems encountered would help us in planning the management. It is important to note that even an occasional use of small amounts of alcohol could lead to major health hazards such as falls and confusion. At the same time, continued long term use can give rise to significant brain damage.

Important Points in Evaluation

1. Screen everyone and get a collateral history
2. Look for physical signs and laboratory findings
3. Come up with a problem list in relation to alcohol use

MANAGEMENT OF ALCOHOL USE DISORDERS AMONG THE ELDERLY

Management depends on the severity of use and the problems patient has. It is important to remember that some of these patients would not be able to stop alcohol altogether. Helping them to manage their lives despite continued use might be the option left for the health care worker. One may encounter significant medical, psychological and social issues in managing patients in this group.

When the usage is small and there are no withdrawal features, the patient could be managed as an outpatient. Pharmacological treatment might not be required in this instance. It is important to remember that benzodiazepines themselves are a major cause of falls and confusion among the elderly.

CONSIDERATIONS IN PHARMACOLOGICAL MANAGEMENT

Detoxification could be challenging. Older age is one indication for in-ward detoxification. The ubiquitous co-existing medical problems prevent safe community detoxification programs. Even with an admission, care should be taken to monitor for complications. For example, the patient could be extremely sensitive to benzodiazepines. It is better to use a shorter acting benzodiazepine such as Lorazepam in this age group. This is doubly important in liver and renal impairment. More frequent dosage (for example four hourly to start with) might be required, but usual six hourly regime is found to be adequate. When a benzodiazepine could not be used, or failed previously, carbamazepine could be used as an alternative. Frequent monitoring for drowsiness, ataxia, confusion and presence of withdrawal syndrome is needed in elderly. Electrolyte imbalances, arrhythmias and seizures could occur and be life threatening hence close monitoring and repeated blood investigations are required. The patient should be adequately sedated, preferably titrated to a rousable daytime light sleep and a deeper slumber at night to prevent complications. It would be advisable to have a bystander all the time in order to prevent falls and minimize confusion.

Thiamine is a must in this instance. High doses such as 600 mg daily using a parenteral route is required in suspected Wernicke's encephalopathy (WE) and malabsorption. Other multivitamins should be added as nutritional deficiencies including Pellagra are common.

Haloperidol would be of use in managing psychotic symptoms and severe agitation during the withdrawal/ detoxification period.

Detoxification

- Use short acting benzodiazepines
- Keep adequately sedated
- Monitor vital signs
- Look out for complications
- Thiamine is a must
- Carbamazepine and haloperidol might be of use

PSYCHOLOGICAL MANAGEMENT

Psychological management of alcohol use disorders poses a major challenge. The long-standing brain damage becomes evident at the outset of old age. The brain is less pliable to start with and is more damage prone from co-occurring diseases such as dementia. Hence, the patients are more susceptible to alcoholic amnesia and other complications.

Increased mental rigidity and inability to learn new things prevent patients from benefitting most from the psychological treatments. Hence a cure or a complete remission might be an over-expectation. The clinician should understand that a more controlled use of the substance would be the best outcome possible in some instances. Even with continued drinking, behavioural changes achieved from clinical input will improve QoL of the patient. Handling unrealistic expectations of the family also is an important aspect in this.

Provision of information and education of the patient and family is the starting point. A reasonable percentage of patients will stop using alcohol with advice. Hence, directly advising them to stop is a worthwhile intervention in an instance where the patient is seen only for a brief assessment and is unlikely to return. Using a method such as FRAMES or motivational interviewing techniques is useful. Education should go beyond the medical complications of alcohol. For example, identifying alcohol as a cerebral depressant and the so called “fun” or stimulatory effects are learnt responses are two important points to highlight. The privileges attached to alcohol could be discussed in a setting where there is abuse following intoxication. Whilst blackouts are known phenomena, the acute memory loss and reported impairment of judgment are just environment related behaviours which could be made to disappear with successful questioning.

- Psychological interventions would be difficult due to the presence of brain damage due to long term use of alcohol
- Abstinence need not be the goal all the time
- Important to address family expectations
- Alcohol is a cerebral depressant and behaviours related to intoxication are mostly learnt

LONG TERM CARE OF THE PATIENT WITH ALCOHOL USE DISORDERS

One of the important aspects of long-term care for these patients is maintaining a non-judgmental attitude irrespective of his compliance. With time, most patients would either stop alcohol or gain some control over their use. Even if the use had not reduced, if there is a positive change in alcohol related behaviour, that should be taken as a successful intervention.

Referral to dedicated counselling services is an option for long term management. However, most counsellors would do the same thing that

the doctors do in their clinic and there might not be an additional benefit unless the counsellor is specially trained.

Naltrexone, and **acamprosate** could be used as relapse prevention medications. The benefits would be marginal. None of these relapse prevention medications were shown to be effective on their own right without a proper psychological management program. Hence, it would be wise not to prescribe if there is no counselling available.

When the brain damage is significant, short term rehabilitation is an option. Even with residential rehabilitation programs, success would be doubtful in some individuals. Evidence suggests that long term residential treatment programs are no better than short term community-based interventions, or clinical interventions by trained professionals.

- Relapse prevention medications are only effective when combined with a proper counselling programme (might not be effective at all among this age group)
- Long-term rehabilitation is no more effective than brief interventions
- Follow up by a clinician, regardless of ongoing use of alcohol tend to improve the condition

PREVENTION OF ALCOHOL USE AMONG THE ELDERLY

General principles of prevention apply here. One important iatrogenic issue that plagues the elderly is advice by the doctors on so called moderate use of alcohol on a regular basis. The concept of safe limits is no longer valid. Alcohol is not considered as safe at all due to two important developments in science. They are:

1. Alcohol is a class 1 carcinogen
2. There is no evidence conclusively supports the claim that alcohol improves cardio-vascular health.

Even a small amount of alcohol can give rise to falls and confusion among the elderly. Medical practitioners should never advocate alcohol as a beneficial drink. Furthermore, alcohol can interact with the drugs that an elderly patient is already on meaning, when it comes to elderly, there is no safe limit. Alcohol therefore should never be “prescribed”.

Most people start their drinking habit in early adulthood. Hence, it is mostly secondary prevention that is applicable for elderly. The following could be recommended as prevention activities:

- Educate about real effects of alcohol (i.e. the reported excitatory effects are learnt behaviours.)
- Educate on real harm of alcohol (limiting life's pleasures to an extreme degree)
- Address attraction built around alcohol
- Address the privileges
- Decrease availability, accessibility and affordability

In essence, the prevention works best when the elderly is made incapable of drinking either due to unavailability or unacceptability in the culture and society. Otherwise, the brain compromised vulnerable group of elderly population would be exploited by the industries for profit. It is the responsibility of the medical profession to go beyond prescribing and engage in community and population level interventions to help our patients.

There is NO safe limit for alcohol

13. Consequences of Impaired Mobility and Stability and Immediate Management

Dr. F H D Shehan Silva

Falls have consequences. Apart from low energy fragility fractures and pathological fractures (due to secondary illnesses such as multiple myeloma and metastasis), hip and vertebral fractures and fractures following an outstretched hand (Scaphoid, Colles and Smiths fractures of the wrist, head of radius and Surgical neck of humerus) are commonly seen in the geriatric population. Furthermore, there can be significant neurological injuries leading to paraplegia and quadriplegia following falls.

Falls also give rise to other significant soft tissue injuries such as abrasions, lacerations, frictional burns (which may require skin grafting and haematoma formation). These can be followed by secondary infections such as cellulitis which is facilitated by other conditions such as a long lie, impaired immunity and metabolic processes such as diabetes mellitus. "A long lie" implies remaining on the floor for more than 1 hour after falling. This is complicated by decubitus ulcers, rhabdomyolysis (leading to acute kidney injury and disseminated intravascular coagulation), hypothermia, dehydration and orthostatic pneumonia. Approximately half of those who lie on the floor for more than one hour succumb within 6 months' even if they do not sustain any physical injury.

Impaction of head can be followed by sequelae such as scalp haematomas, cranial and facial fractures, periorbital haematomas (complicated with orbital cellulitis), base of the skull fractures (followed by CSF rhinorrhoea and meningitis) and cervical spine fractures.

The psychological sequelae following falls also constitute an important aspect which is poorly identified. Post-fall Anxiety Syndrome (Fear of further falls) is common up to 30% of individuals. This is a disabling condition leading to feeling of insecurity, immobility and institutionalization and increased mortality. This may occur in approximately half of those after a hip fracture and is associated with

living alone, cognitive impairment, depression, physical impairment and history of falls. New onset fear of falling is also predicted with obesity.

Geriatric patients need to be evaluated thoroughly even if they have sustained a minor injury regardless of the circumstance or mechanism. The standard primary survey is suitable in this age group. A comprehensive description is beyond the scope of this article and the author suggests the reader to refer the latest advanced trauma life support or resuscitation guidelines.

AIRWAY & BREATHING

- When securing the airway patency, it is essential that conditions such as temporomandibular arthritis and dentures are considered.
- Bag and mask ventilation become difficult after removal of dentures and therefore may be necessary to retain them if assisted ventilation is needed.
- Early administration of supplemental oxygen is important as elderly patients have a low physiological reserve.
- Early tracheal intubation may be necessary as diminished reserves may prevent recovery.
- Drugs used in rapid sequence induction (e.g. benzodiazepines, barbiturates) may cause haemodynamic compromise therefore require half the dose compared to younger adults.
- Noninvasive positive pressure ventilation has shown to prevent tracheal intubation.

CIRCULATION

- Baseline hypertension is common in elderly and in trauma may reflect a false normality when blood pressure is in normal range.
- Betablockers and antihypertensives may blunt the tachycardic response in shock.
- Subtle alteration of mental status, mild tachypnoea, delayed capillary refill and oliguria may point towards hypoperfusion.

- Aggressive resuscitation is needed against hypo-perfusion but cautiously considering ischaemic heart diseases and congestive heart disease.

DISABILITY AND SECONDARY ASSESSMENT

- Accurate assessment of neurological function can be difficult especially in those with cognitive disorders.
- Older patient has lower pain perception and may have difficulty in localizing pain.

HEAD INJURY

Head Injury is an important sequelae of falls which is often mismanaged. Older adults with severe traumatic brain injury (TBI) (GCS<9) is at 80% likelihood of mortality and long-term institutionalization. There should be a thorough history taking and full neurological evaluation in any patient with TBI. Reliance on GCS may be less accurate in elderly, as a high as well as low score (due to cognitive disorders) may mask concealed injury. A low threshold should be kept for a non-contrast CT of the head (The Canadian CT Head Rule for those above 65 years and New Orleans Criteria for those above 60 years with mild TBI). Any patient with new focal or generalized neurological manifestations, history of syncope or seizures at the time of the event and those taking anticoagulants should undergo brain imaging. Older patients on warfarin who have evidence of post traumatic intracranial haemorrhage should have INR corrected towards normal range (< 1.6x normal) within two hours of admission.

SPINAL INJURY

The geriatric population can endure cervical fractures even with subtle mechanisms, even from a fall from erect position. High cervical fractures such as odontoid injuries are significant. Central cord syndrome is a condition which can cause greater motor impairment of the upper limbs compared to the lower limbs with bladder bowel dysfunction and sensory loss below the level of injury. This is caused by hyperextension of neck of those having longstanding cervical spondylosis. The risk off

spinal cord injury is augmented by superimposed conditions such as canal stenosis, degenerative rheumatoid and osteoarthritis. Cervical imaging by CT scans should be arranged for those at risk of spinal injury after a trauma. The Canadian C-spine Rule states that all patients with suspected cervical spine injuries above 65 years should undergo imaging. Immobilization of the spine should be carried out on any person with suspected spinal injury with hard collars and spinal boards. Neurosurgical opinion should be sought in such cases. Clinicians also need to be considerate about preventing decubitus ulcers in those who are immobilized.

CHEST TRAUMA

The most common chest injury sustained by elderly are rib fractures which are associated with high risk of mortality and morbidity. Blunt chest wall impaction can give rise to pneumonia and pulmonary contusion even with 3 or less nondisplaced rib fractures. Mortality has shown to increase by 19% for each rib fracture in those above 65 years of age.

ABDOMINAL TRAUMA

Increased laxity of abdominal wall muscles and reduced pain sensation places abdominal examination less reliable in elderly. A low threshold should be kept for those even with blunt trauma to undergo an ultrasound scan abdomen or a CT Abdomen or even a CT Traumagram (Cervical region to pelvis) with clinical judgement.

MUSCULOSKELETAL INJURY OF PELVIS, HIP AND EXTREMITIES

Hip fractures are the most common injury that needs admission to a hospital. Plain radiographs of the pelvis/Hip are not sensitive in detecting subtle fractures. Lateral compression fractures of the pelvis are more common in elderly compared to younger adults. Pelvic fractures are also accompanied by significant mortality and morbidity. All geriatric patients with pelvic and hip fractures should be considered haemodynamically unstable until proven otherwise as there can be

concealed bleeding. Early radiological evaluation and surgical/orthopaedic referral should be considered.

Analgesia

Early pain control is essential to provide comforting care and to reduce delirium. The WHO pain ladder is a useful protocol to consider which agent to use. Change in physiology in elderly results in higher concentrations which requires reduction of standard dosages. Paracetamol and opioids are used best for significant pain in elderly. However, morphine has a toxic metabolite (causing respiratory depression and seizures) that has renal clearance, therefore making it unsuitable in end stage renal disease. Non-steroidal anti-inflammatory agents (NSAIDS) are best avoided in view of renal effects and possible upper gastro-esophageal bleeding.

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14. Clinical evaluation - Balance, Gait and Mobility Disorders

Dr Chandana Kanakarathne

Accurate assessment of gait, balance, and mobility in older adults is an important aspect of clinical practice for clinicians. Gait, balance and mobility disorders are an important group of conditions which lead to high risk of falls. Therefore, evaluation of them warrants in needy people.

WHO SHOULD BE OFFERED THE EVALUATION?

1. Older person, especially the frail and vulnerable, should be asked for falls every year and offered an evaluation
2. Those who have recurrent falls
3. Those who demonstrate gait and balance abnormalities or report difficulties in walking or balance

EVALUATION

Comprehensive and includes following components.

- a. History from patient and the carers/family
- b. Physical examination of all systems
- c. Measures of gait, balance and mobility

HISTORY

- Obtain patient's description of the difficulties with gait, balance and mobility. Identify the factors which lead to these difficulties. For example, arthritis, backache, dizziness, cognitive impairment, vision impairment.
- Detailed Information regarding current and previous falls including the circumstances lead to them and potential risk factors associated with each episode should be reviewed.
- Collateral history from the family and caregiver is very important and informative and should be sought whenever possible.

- Review all recognized acute and chronic medical issues patient suffers with and, determine the relative contribution of each for the difficulties with balance and gait as well as for falls.
- Review organ systems to identify unrecognized reasons for the above difficulties.
- Thorough review of the drugs patient takes is imperative. Review the need for them and the side effects and interactions affecting the balance and gait. Consider possibility of cutting down the number of drugs to a minimum.
- Review the impact of the gait and balance difficulties on one's day to day functioning and the quality of life.
- Review the home circumstances to facilitate the maximum independence. Certain adaptations may need to be in place to reduce impact of balance and gait difficulties. For instance, need for railings to stairs, toilets, bedroom, unsafe corridors or considering living at one level
- Review the environmental hazards inside and outside living environment. For instance, electric wires on the ground, moving carpets, slippery tiled floors, steps and humps, clutter, lack of grab bars in toilet, low chairs, poor lighting,
- Determine the pre-morbid functional level

PHYSICAL EXAMINATION

Review all systems

- Cardiovascular - pulse for arrhythmias, high or low blood pressures, orthostatic blood pressure drops, evidence of heart failure
- Pulmonary - chronic lung diseases, infections
- Neurologic issues such as muscle weakness and impairments of coordination, impaired cerebellar and vestibular function, impaired peripheral sensation, presence of tremor and bradykinesia

- Musculoskeletal issues such as joint swelling, deformity, or instability, limitations in range of motion in knees and hips, back and neck aches, stiffness and limitation of movements, ankles and feet deformities, kyphosis and scoliosis, and so on. Assess the posture
- Sensory impairments (vision, hearing, peripheral neuropathy)
- Cognitive and mood assessments – For cognitive assessment short screening such as 6-CIT used and when abnormal proceed with Montreal Cognitive test (MOCA – available in all 3 languages) or Mini-Mental Score (MMSE). Mood disorders can be assessed by Geriatric Depression Scale (GDS) or Hospital Anxiety and Depression Scale (HADS)
- Assess for fear of falling

SPECIALIST PROCEDURES FOR ASSESSMENT OF GAIT, BALANCE AND MOBILITY (FOR DETAILS SEE ANNEXURE 2)

- **Gait assessment**
 - Observation of gait – aspects of the gait observed are stance, posture, initiation, velocity, step length, symmetry, cadence, fluidity of movements, instability, and need of assistance (see annexure 1 for definitions).
 - Gait speed - 4m or 10m walk test - modified Gait Abnormality Rating Scale (GARS-M)
 - Gait endurance- 6m walk test
 - Dual Task Performance During Gait - walking while talking (WWT) test
- **Balance and Mobility**
 - Timed up and go test (TUG)
 - Functional reach test
 - Sit and stand test
 - Backward walking test
- **Balance assessment**
 - Berg Balance scale
 - Mini-Best test

- Both tests are time consuming and may not be practical in most busy clinical situations. However, they can be employed in Comprehensive Geriatric Assessment to have greater understanding of the issues.

Choice depends on the practicality of using them to suit the situation. In busy outpatient settings it will be difficult to use more time-consuming tests and, therefore you need to resort to simple but informative tests to use routinely in clinical practice. TUG will offer a satisfactory indication towards balance, mobility and falls risk. Use of a second test such as 'sit to stand test' or 'the functional reach test', in addition to TUG, improves chances of predicting the risk of falls but performing more than 2 tests will not improve the sensitivity greatly.

Elderly with balance or gait issues, and repeated falls or fear of falls should undergo a Comprehensive Geriatric Assessment with multiple specialists including doctors for medical issues and risk factor determination, nurses for nursing issues, therapists esp. the physiotherapists and occupational therapists for optimal rehabilitation, and also specialist consultants and their services, as and when needed, along with dedicated coordination by a geriatrician. Through such multi-disciplinary assessment, planning and intervention we can provide holistic care to improve independence and the quality of life.

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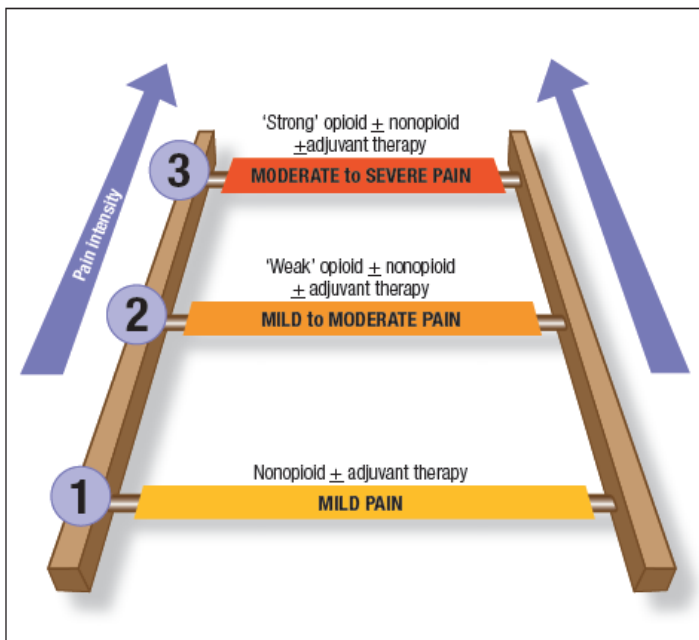


Figure 1. WHO Three-step Pain Ladder. This analgesic step ladder has been the treatment standard most used during the past 3 decades.

REVERSAL OF ANTICOAGULANTS

The incidence of intracranial haemorrhage in patients on anticoagulants is high, particularly so, following TBI. Even therapeutic levels of anticoagulation follow worse outcome in elderly patients. Reversal of this needs to be attended promptly as it changes mortality and morbidity.

Setting	2018 American Society of Haematology Guidelines (ASH)
Serious or life-threatening bleeding Any INR	Hold Warfarin Intravenous Vitamin K 4 factor Prothrombin Complex Concentrate
No bleeding INR > 10	No recommendations <i>N.B. 2012 American College of Chest Physicians (ACCP)</i> <i>Hold warfarin</i> <i>Oral Vitamin K 2.5-5 mg</i>
No bleeding INR 4.5-10	Hold warfarin No vitamin K (ASH guidelines) <i>Oral low dose (1-2,5 mg) vitamin K optional (ACCP guidelines)</i>

In serious life-threatening bleeding, 4-Factor Prothrombin Complex Concentrate (PCC e.g. Beriplex, Octaplex) rather than 3-Factor PCC are advocated. In resource limited settings, non -cross matched fresh frozen plasma (FFP) using the smallest volumes (to minimize fluid overload e.g. 2-3 units at 15-30ml/kg) may be given to shorten the time of reversal. Antifibrinolytics such as tranexamic acid may be used. Platelet transfusion may be used in the setting of thrombocytopenia to achieve a target of >50,000/uL. Correction of low haemoglobin is also of utmost importance.

15. Stability and Mobility: Physiotherapist's Role

Ms. Theruni Wijewardene

During ageing process, a significant number of changes occur in the body that ultimately translates to the cardinal feature of the ageing itself as loss of function. This loss of function has wide-ranging consequences for the individual and for family, carers and society in general. Some natural age-related changes and a myriad of co morbidities which have been discussed in earlier pages, are responsible for this. These physical and mental changes are likely to affect the mobility and stability of the elderly population, thus making them more susceptible to falls and fractures, reducing their functionality and independence, and reduce their overall quality of life. Physiotherapists play an integral role in the multidisciplinary team to improve and maintain stability and mobility in the elderly population through screening, appropriate assessment and individualized interventions.

The most critical part of an initial consultation with the Physiotherapist is the assessment of the patient both subjectively and objectively to identify any limitations in movement and function. Although Physiotherapists commonly treat balance and strength impairments, standardized falls screening is not fully incorporated into daily practice. During the assessment of older adults (>65 years of age), regardless of their initial complaint or reason for referral for physiotherapy, screening for falls should be a part of the standard physiotherapy evaluation (Shubert, 2011). Screening includes: (1) asking the individual if they have experienced a fall over the past year, (2) asking if they are experiencing difficulty with walking or with their balance, and during the objective examination (3) observing whether performance of walking and balance is compromised using outcome measures such as the Timed Up and Go test or other balance assessments. If one or more of these screens are 'positive' the therapist should perform a comprehensive falls risk assessment as part of the standard physiotherapy evaluation. There are multiple risk factors that increase the likelihood of falls, including previous history of falls, urinary incontinence, fear of falling, cognitive impairments etc, and physiotherapists are able to assess some of these

risk factors within their scope of practice, and need to refer to other health care providers for other risk factors outside their scope of practice (eg polypharmacy and visual impairments, among others).

Several reliable and validated tools are used by Physiotherapists to assess stability and mobility across the continuum of function. These include Berg Balance Scale, Dynamic Gait Index, and Timed Up and Go test. These tools provide a baseline measurement of the patient and can be used to provide the patient and caregivers with advice on exercise, ambulatory aids, activity modification and falls risk. Once risk factors are assessed and impairments are identified, the Physiotherapist can plan and implement an appropriate intervention for the patient. Interventions may include individualised or group exercise programs, advice on footwear, home and activity modifications, prescription of assistive devices and ambulatory aids, education for patients and caregivers, as well as regular monitoring.

Physiotherapists, as trained exercise interventionists, are ideally positioned to improve population health through delivery of safe and evidence-based rehabilitation for older adults with frailty. A thorough assessment of the patient's musculoskeletal system, gait pattern and other difficulties is essential to prescribe a specific and relevant exercise program that will yield optimal results. Once activity limitations are identified (eg walking - limping due to knee pain), the physiotherapist determines contributing impairments (eg: weak quadriceps and hip abductors leading to excessive knee flexion and internal rotation during stance phase of gait) and then plans and implements a specific, individualized exercise program (eg: quadriceps and hip abductor strengthening – standing VMO activation and side lying hip abduction) that aims to improve function.

Exercises may include strengthening, flexibility, balance and proprioception improvement measures, as well as functional movement exercises such as gait re-training and sit to stands and activities to promote aerobic exercise capacity such as stationary cycling. More recently, there is research evidence showing specific motor skills training, rather than standard impairment-based exercise programs alone, may be more effective for improving function. For example,

elderly patients with poor gait characteristics such as slow and variable gait, showed greater improvements in walking efficiency, walking speed and self-perceived walking ability with task orientated motor training, compared to a standard impairment-based exercise program (Van Swearingen et al, 2009). Characteristics of motor learning include specific positioning, defining a specific goal or task, repetitive accurate practice with or without variations in performance conditions, and feedback knowledge of successful performance. For example, during gait training, an example of a defined goal may include walking in a curved path; repetitive practice with variations may include varying the path from left to right or right to left; and providing feedback visually, through video recording, and verbally by highlighting some aspect of the movement pattern that the patient finds difficult to perceive. Incorporating task orientated motor learning into standard rehabilitation can improve efficiency, reduce energy demands and sustain long term results (Brach et al, 2015; Van Swearingen et al, 2014). Ongoing evaluation is ideally performed at regular intervals based on the individual's requirements (eg initially weekly or fortnightly, and then monthly), to monitor, modify and/or progress programs.

Falls among the elderly population is common and can have devastating consequences and place a huge burden on health services. Physiotherapists can play a crucial role in preventing falls in older patients through screening, ongoing assessment and implementation of exercise programs. Current evidence indicates that group exercises, home safety and multifactorial interventions prevent falls in community-dwelling older people who are at an increased risk of falls (Sherrington & Tiedemann, 2015). However, there is much variation in the frequency, intensity and duration of exercise therapy prescribed to achieve optimal results. Berg Balance Scale score (≤ 50 points), Timed Up and Go times (≥ 12 seconds), and 5 times sit-to-stand times (≥ 12 seconds) are currently the most evidence-supported functional measures to determine individual risk of future falls (Lusardi et al, 2017). For the community-dwelling elderly population, a minimum of 50 hours of progressive exercise that focus on moderate to high-intensity balance exercises appears to be one of the most effective interventions to prevent falls (Shubert, 2011). Ongoing community-based rehab

programs such as balance and strengthening classes for the elderly in gyms, aquatic centers, elderly institutions, as well as private and public physiotherapy clinics can be effective for maintaining stability and mobility in the elderly population. Physiotherapists are ideally suited to conduct small to medium size group exercise classes within the community and need to promote their role further with relevant stakeholders.

Examples of Balance Challenging Exercises (Adapted from Tiedemann et al, 2011)

Exercise	Progression
Graded reaching in standing	<ul style="list-style-type: none"> Narrower foot placement Reaching further and in different directions Reaching for heavier objects Reaching down to a stool or the floor Standing on a softer surface (eg, foam rubber mat) Stepping while reaching
Stepping in different directions	<ul style="list-style-type: none"> Longer or faster steps Step over obstacle Pivot on non-stepping foot
Walking practice	<ul style="list-style-type: none"> Decrease base of support (eg, tandem walk) Increase step length and speed Walking in different directions Walking on different surfaces Walk around and over obstacles Heel and toe walking
Sit to stand	<ul style="list-style-type: none"> Don't use hands to push off Lower chair height Softer chair Add weight (vest or belt)
Heel raises	<ul style="list-style-type: none"> Decrease hand support Hold raise for longer One leg at a time Add weight (vest or belt)
Step-ups: forward and lateral	<ul style="list-style-type: none"> Decrease hand support Increase step height Add weight (vest or belt)
Half squats sliding down a wall	<ul style="list-style-type: none"> Decrease hand support Hold the squat for longer Move a short distance away from the wall Add weight (vest or belt) One leg at a time

One of the main roles of the physiotherapist involved in aged care is to promote exercise and movement through education and awareness programs. Physiotherapists are able to improve home safety, maintain function, improve physical activity, and reduce falls risk. Physiotherapists are also able to provide recommendations for appropriate home health care assistance given the extent of mobility or

activities of daily living limitation. Educating the patient as well as caregivers improves adherence to programs and interventions and are likely to result in improvements or maintenance of function and reduce the speed of decline in elderly patients. Explanations of assessment findings and management recommendations linked to research and successful clinical outcomes, use of anatomical pictures and models and opportunities to answer questions and summarize main points all promote deeper learning. Patient education should also include advice about pain management, activity modification and correct use and maintenance of aids (e.g. walking aids or braces). Physiotherapists can also engage the patient and caregivers in problem-solving of self-management needs. For example, Physiotherapists can teach how to monitor and report mobility-related warning signs such as declines in gait speed or new impairments in daily activities. Patient self-monitoring, early detection of new or worsening impairments, and communication with the health care providers can potentially mitigate costly, avoidable hospitalization and institutionalization.

Physiotherapists are also involved in prescribing ambulatory assistive devices (e.g. canes or walking sticks, crutches, and walkers) which provide advantages such as stability, augmentation of muscle action, and reduction of weight-bearing load that allows the older adult to maintain their independence. Although ambulatory assistive devices are often prescribed, a detailed understanding of these devices is often lacking, which may lead to detrimental consequences. Appreciating the types of assistive devices, their modifications, associated gait patterns, physiologic demand, proper fitting, and indications for use is essential in prescribing the proper device.

Physiotherapists play a vital role in aged care, particularly in screening and assessing, as well as maintaining and improving stability and mobility through well-designed exercise interventions and ambulatory aids for elderly patients. Physiotherapists have a significant scope of practice and need to offer and promote their services through one or more of the following: individualized prescription of home-based programs; offer group programs in private practice or hospital departments; and raise community awareness by educating about the

importance of exercise in maintaining stability and mobility in the elderly population (e.g. talks to groups of older people, fellow health professionals, articles for newspapers, and through social media). They also have a duty of care to screen patients for risk factors that compromise the older patient's stability and mobility, and refer for specialized interventions such as medication management, occupational therapy for home assessments, and eye specialists for visual impairments etc. Although no one can stop the ageing process, by working together in a multidisciplinary framework, health professionals, including physiotherapists, can reduce the detrimental impacts of ageing on the elderly persons' bodies and their lives.

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16. Role of Occupational Therapist in Enhancing Mobility and Fall Prevention

Mr. Nandana Welage

Mobility is a skill developed from infancy, childhood to adult life. Mobility allows people to explore, control and adapt to the environment and maintain personal, social and working life. Therefore, mobility is an integral part of life. However, in adult life mobility can be restricted due to various reasons. Research shows that one in four adults above the age of 65 experiences a fall each year. Falls may lead to devastating consequences, including hip fractures, traumatic brain injury, and reduced mobility which affect the performance of activities of daily living.

Occupational therapy practitioners (OTs) are equipped with knowledge and skills to maintain or increase the level of mobility of a person. Occupational therapists provide remediation and compensatory training after assessing the intrinsic and extrinsic factors which cause restriction of mobility. After identifying the specific cause of mobility impairment, OTs conduct mobility skills training depending on the person's level of mobility impairment. This article outlines the techniques of transferring and mobility, provision of assistive devices and environment modifications to increase a person's level of mobility.

TRANSFERRING TECHNIQUES

To achieve even the most basic level of independence, a person needs to transfer from bed to chair and from the toilet and bathroom. The OTs role, therefore, is to enable the person to achieve independence in transferring. If independent transferring is not possible, then assisted transferring method is considered. However, if a person's mobility is severely affected, lifting and moving could be arranged using a hoist.

Independent transferring method is suitable for persons who have enough energy and strength to control body weight and able to move a short distance. Such persons are trained to move independently from bed to chair or wheelchair, then transfer from wheelchair to toilet or

bath seat in a safe and efficacious manner. Several types of transferring methods such as side, front and corner transfer methods can be trained depending on the abilities and strength of the person. OTs help the person to identify the safest and the most comfortable method to practice.

The assisted transferring method may be useful for those who are not strong enough to transfer independently but have the energy and strength to move with the support of a carer. OTs train both the person and his or her carer to support in getting up from the bed and transfer to the chair, commode, bath seat etc. The pelvic hold, the elbow hold and the arm hold are some of the assisted transfer methods commonly practiced. The primary concern of these techniques is the comfort and safety of both the person and the carer, as this technique will help to minimize back injuries of the carer which is a common complaint with handling people with disabilities.

Mechanical lifting aids such as hoist are designed to lift or transport persons who are mostly immobile or bedridden. OTs evaluate the needs of the person, carer and the features of the environment to identify the suitable equipment. After introducing the hoist, OTs provide training to the user and carer on how to handle the hoist. Several types of hoists such as mobile, fixed overhead and car hoists are available to choose according to the requirement. However, these types of mechanical devices are expensive and still not widely used in Sri Lanka.

WHEELCHAIRS

If the person is unable to walk, introduction of a wheelchair may be the best option to restore mobility. The most important aspect of wheelchair provision is that the chair should meet the body size, disability and the needs and expectation of the user. Thus, the wheelchair should enhance the activities person wishes to perform at home, work or social/leisure pursuits. OTs are familiar with a wide variety of wheelchairs, their features and accessories. Hence, OTs support to identify the most suitable model by taking the measurements of the user and decide the type and the specification of the wheelchair needed to meet the person's need.

WALKING AIDS

When the mechanism of walking is impaired, a variety of mechanical walking aids can be tested and are available to provide stability while moving. Walking aids range from large free-standing walking frames to less stable walking aids such as walking sticks. Walking frames are more suitable for persons with poor standing balance as it increases the base of support so that the person can transfer body weight on the frame. Aids such as walking sticks and crutches are suitable for persons who have some stability to maintain the standing posture while engage in walking. Provision of such walking aids need assessment followed by specific walking training. Physiotherapy colleagues mostly provide assessment and provision of walking aids. However, OTs are involved in functional mobility training such as, engage in activities of daily living, work and leisure pursuits, using the walking aid.

ENVIRONMENTAL ASSESSMENT

OTs also conduct specific assessments to screen a person's home hazard, which may compromise with mobility, especially in old age. The Home Falls and Accidents Screening Tool (HOME FAST) has been designed to identify older people at risk of falling because of hazards within their home. The home refers to both inside and outside the person's residential property. HOME FAST is often used in occupational therapy practice in Sri Lanka. This assessment helps to identify important areas which may lead to falls including 1) condition of the floor; 2) arrangement of furniture; 3) brightness of the lighting; 4) condition of the bathroom and toilet; 5) storage; 6) stairways; and 7) person's mobility.

ENVIRONMENT MODIFICATION

Upon identification of risk factors of falls, OTs guide the person and family to overcome them. The floor area of the house may have a slippery walking surface, full of clutter and loose mats. In some houses the staircase may not have a proper installation of handrails to hold or the edge of the steps may not be identified clearly and also the visual pattern of the tiles or carpet may confuse to identify the edge of the

steps that can increase the risk of falls. In such situations, OTs provide the necessary technical guidance to identify a non-slip material to cover slippery floor areas, specifications of height and diameters of the handrails and ways to highlight the edge of the stairs in order to bring contrast.

Illumination is an important aspect which is often neglected by older people and their families. Many older people experience poor eyesight therefore, OTs provide the necessary technical advice such as regarding accepted level of voltage of a light bulb (which should be more than 75W) in all areas of the house and lighting without shadows. Also, to have a bedside light will be convenient as older people often need to get up in the middle of the night to use the toilet due to age-related difficulties in urination.

Safety in the bathroom and toilet are also assessed. Especially the height of the commode is arranged in such a way that the person will not need to hold onto sink or towel rail or toilet roll holder to get up. If the person is at risk of losing balance when getting in and out of toilet or bathroom, grab bars and handrails are designed, and installation instructions are given to the person and the family. Even though commodes are commonly used in cities and suburbs, squatting pans are still widely used, especially in rural areas. In such situations, modification or alternatives are suggested to match with the person and environment.

In addition to permanent modifications to the home front, simple home arrangements are also suggested. Advice is given to store equipment and supplies that are used regularly between the eye and hip level in order to minimize bending and stooping. Removing the items that are cluttering pathways and arranging furniture to get clear space to walk, repositioning the bed are some measures that is taught. These simple yet crucial modification can make a remarkable impact on the stability and mobility of older people for the betterment.

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ANNEXURE 1

GAIT TERMINOLOGY

Term	Definition	
Gait speed	Distance walked per unit time	
Step width	Lateral distance between the heels for consecutive heel strikes of the two feet	<p>The diagram shows a sequence of footprints illustrating gait parameters. A horizontal double-headed arrow between the heels of two consecutive footprints of opposite feet is labeled 'STEP WIDTH'. A vertical double-headed arrow between the heels of two consecutive footprints of the same foot is labeled 'STRIDE LENGTH'. Another vertical double-headed arrow between the heels of two consecutive footprints of opposite feet is labeled 'STEP LENGTH'.</p>
Stride width	Perpendicular distance from the heel of one foot to the line connecting two consecutive heel strikes of the contralateral foot	
Step length	Distance between the heels in the anteroposterior direction for consecutive heel strikes of opposite feet	
Stride length	Distance between the heels in the anteroposterior direction for consecutive heel strikes of the same foot	
Stride time	Time between consecutive heel strikes of the same foot	
Cadence	Number of steps taking per unit time	
Gait variability	Step-to-step deviations/variations in gait parameters	
Gait cycle	One complete cycle of one limb starting when the foot first contacts the ground to when the same foot next contacts the ground	

Stance phase	Phase of gait cycle from touchdown to lift off of the same foot	
Swing phase	Phase of gait cycle during which the foot of interest is not on the ground	
Double support	Both feet are simultaneously contacting the ground single support	
Single support	Only one foot is in contact with the ground	

Reference : Osoba MY, Rao AK. Balance And Gait In The Elderly: A Contemporary Review. *Laryngoscope Investigative Otolaryngology* . 4; February 2019: 143-153

ANNEXURE 2

BALANCE AND MOBILITY TESTING

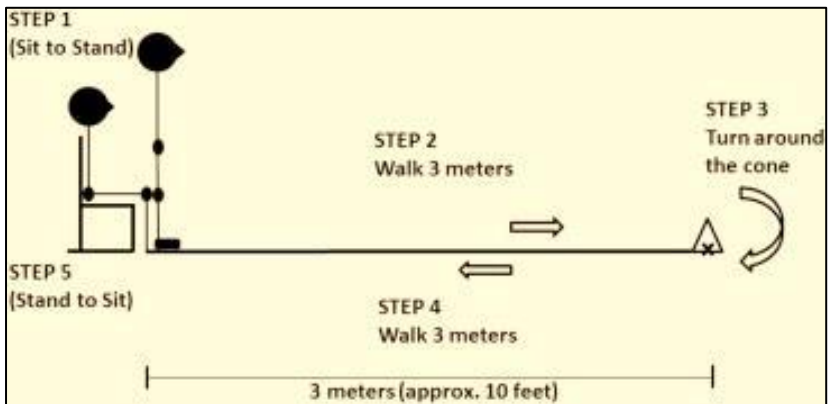
Timed Up and Go Test (TUG)

Description: TUG measures the time taken for a person to rise from a chair, walk three metres at normal pace with their usual assistive device, turn, return to the chair and sit down.

Time needed for testing: 1–2 minutes

Criterion: A time of ≥ 12 seconds indicates increased risk of falling

Advantages: a reliable diagnostic tool for gait and balance disorders, and is quick to administer



Sit-to-Stand Test (STS)

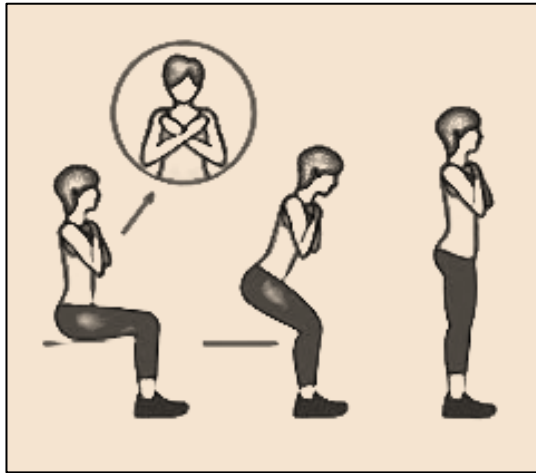
Description: STS provides a measure of lower limb strength, speed and coordination.

Instruction: It involves the time taken to complete five sits to stand (STS) sequences as fast as possible without the use of hand support from a chair of standard height (43 cm).

Time needed for testing: 1–2 minutes

Criterion: A time of ≥ 12 seconds indicates increased risk of falling

Interpretation: Predict future mobility disability and disability in activities of daily living. Evaluates balance and postural stability and used to predict fall risk



Alternate Step Test (AST)

Description: AST provides a measure of lateral stability and involves the time taken to complete eight steps, alternating between left and right foot, as fast as possible up onto a step that is 19 cm high and 40 cm deep.

Time needed for testing: 1–2 minutes

Criterion: A time of ≥ 10 seconds indicates increased risk of falling

Six-Meter Walk Test

Description: measures a person's gait speed (over 6 meters) at his/her normal walking speed.

Interpretation: A time of > 6 seconds indicates high risk of falls.

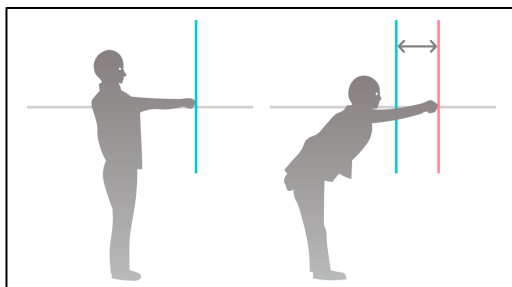
Functional Reach

Description: FR is a simple and easy-to-use clinical measure of balance and has predictive validity in identifying recurrent falls

Requirements: The patient must be able to stand independently for at least 30 seconds without support and be able to flex the shoulder to at least 90 degrees.

Equipment and Set up: A yard stick is attached to a wall at about shoulder height. The patient is positioned in front of this so that upon flexing the shoulder to 90 degrees, an initial reading on the yard stick can be taken. The practitioner takes a position 5-10 feet away from the patient, viewing the patient from the side.

Instructions: Position the patient close to the wall so that he or she may reach forward along the length of the yardstick. The patient is instructed to stand with feet shoulder distance apart then make a fist and raise the arm up so that it's parallel to the floor. At this time, the practitioner takes an initial reading on the yard stick, usually spotting the knuckle of the third metacarpal. The patient is instructed to reach forward along the yardstick without moving the feet while the hand remaining in a fist. The practitioner takes a reading on the yardstick of the farthest reach attained by the patient. The initial reading is subtracted from the final to obtain the functional reach score. Three trials are done and the average of the last two is noted.



Interpretation:

- $<10'' = 2x$ more likely to fall (significant risk of falls)
- $<6'' = 4x$ more likely to fall (moderate risk of falls)

Backward walking test

Description: More accurate identifier of fallers than forward walking speed in elders.

Interpretation: Speed of less than 0.6 m/s is indicative of fall risk.

Berg Balance scale

ITEM DESCRIPTION	SCORE (0-4)
1. Sitting to standing	
2. Standing unsupported	
3. Sitting unsupported	
4. Standing to sitting	
5. Transfers	
6. Standing with eyes closed	
7. Standing with feet together	
8. Reaching forward with outstretched arm	
9. Retrieving object from floor	
10. Turning to look behind	
11. Turning 360 degrees	
12. Placing alternate foot on stool	
13. Standing with one foot in front	
14. Standing on one foot	

The Berg Balance Scale is a 14-item scale designed to measure balance of the older adult in a clinical setting with a maximum total score of 56 points

ANNEXURE 3

MEDICAL CONDITIONS AND RISK FACTORS ASSOCIATED WITH GAIT AND BALANCE DISORDERS

<p>Cardiovascular diseases</p> <p>Arrhythmias Congestive heart failure Coronary artery disease Orthostatic hypotension Peripheral arterial disease Thromboembolic disease</p> <p>Neurologic disorders</p> <p>Cerebellar dysfunction or degeneration Delirium Dementia Multiple sclerosis Myelopathy Normal-pressure hydrocephalus Parkinson disease Stroke Vertebrobasilar insufficiency Vestibular disorders</p> <p>Sensory abnormalities</p> <p>Visual impairment Hearing impairment Peripheral neuropathy</p> <p>Musculoskeletal disorders</p>	<p>Infectious and metabolic diseases</p> <p>Diabetes mellitus Hepatic encephalopathy Human immunodeficiency virus-associated neuropathy Hyper- and hypothyroidism Obesity Tertiary syphilis Uraemia Vitamin B12 deficiency</p> <p>Affective disorders and psychiatric conditions</p> <p>Depression Fear of falling Sleep disorders Substance abuse</p> <p>Other</p> <p>Other acute medical illnesses Recent hospitalization Recent surgery Use of certain medications (i.e., antiarrhythmics, diuretics, digoxin, narcotics, anticonvulsants, psychotropics, and antidepressants), especially</p>
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Cervical spondylosis Gout Lumbar spinal stenosis Muscle weakness or atrophy Osteoarthritis Osteoporosis Podiatric conditions	four or more
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