17th WORKSHOP ON NEUROOTOLOGY

Dementia & Imbalance

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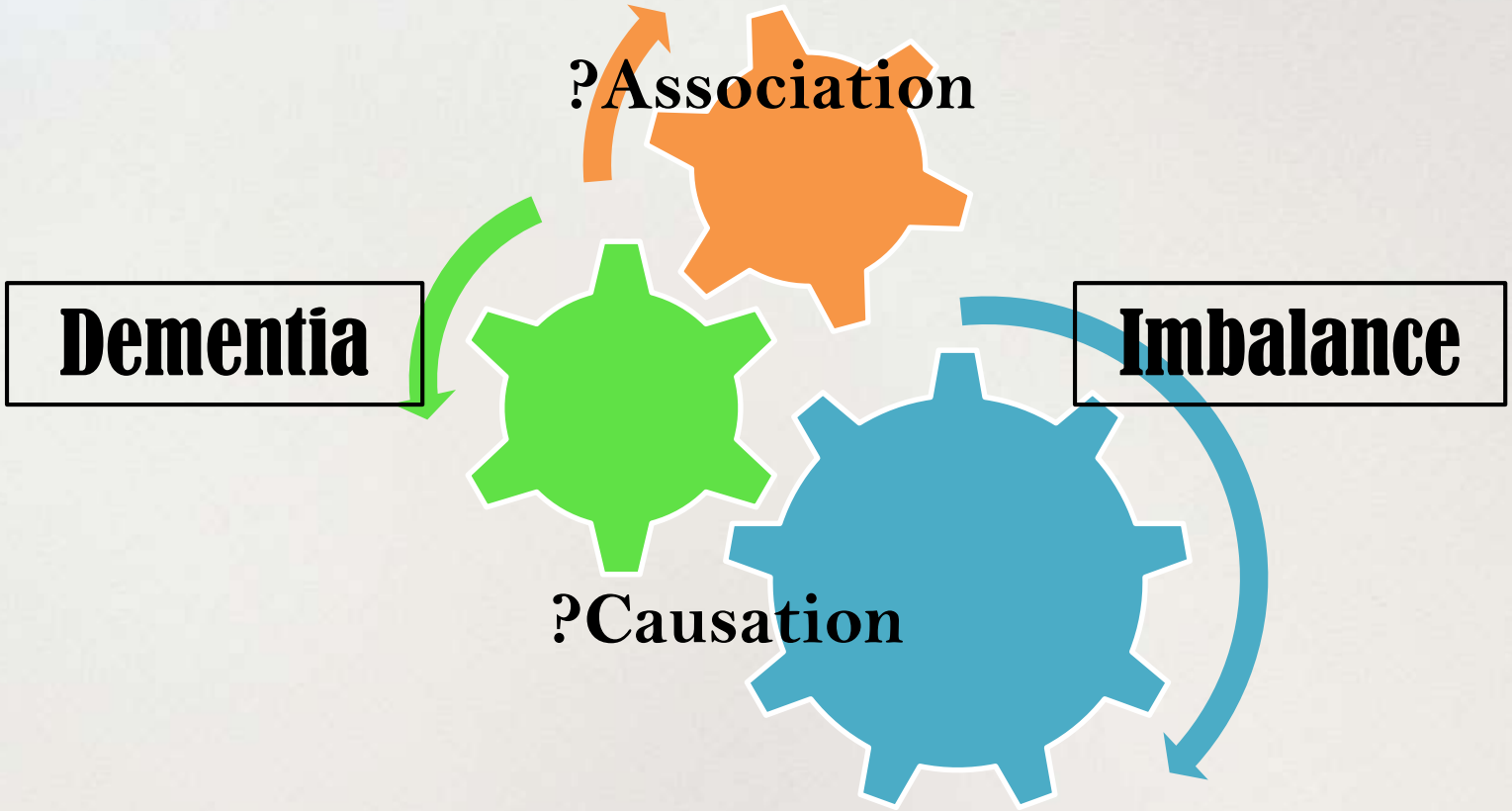
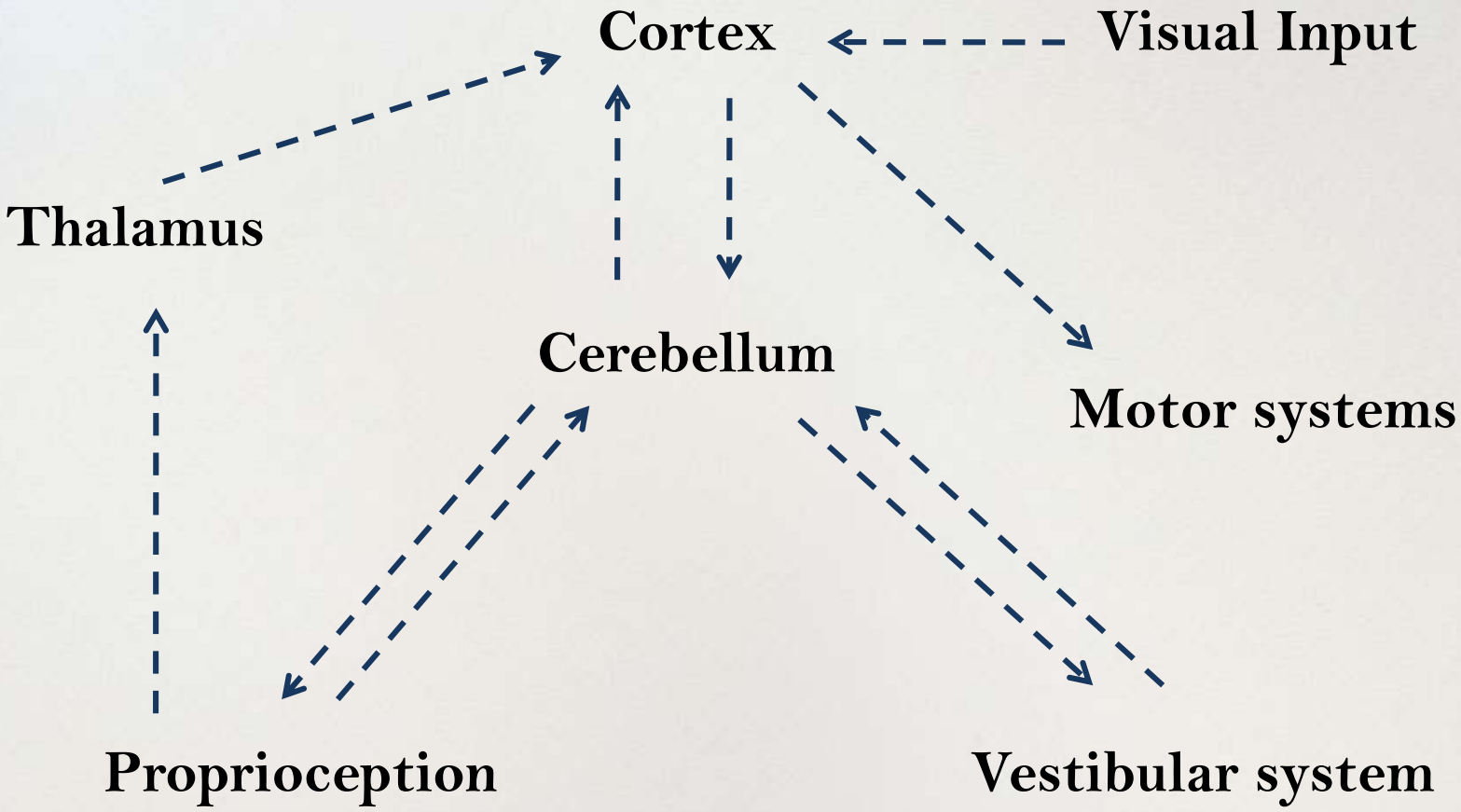

?Association
Dementia
Imbalance
?Causation

balance:

- An even distribution of weight enabling someone or something to remain upright and steady. (OUP)
- Maintenance of a stable, erect posture without any support either in static (sitting/standing) or dynamic condition (walking).



(Over) Simplified view of subsystems involved in maintaining balance

Vestibular cortex

- Parieto-insular cortex is vestibular cortex (PIVC) in humans
- PIVC receives inputs from both semicircular canals and otoliths
- It interacts with the visual cortex to match the two 3D maps

- *Brandt et al. Ann New York Acad Sci 1999*

Relationship between gait/balance and cognition

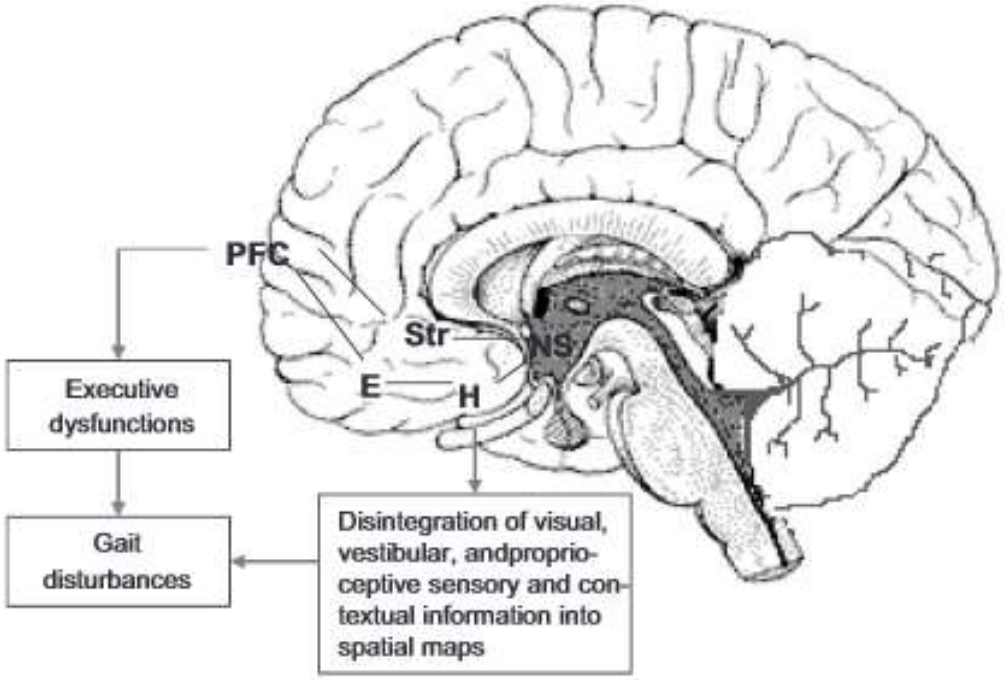
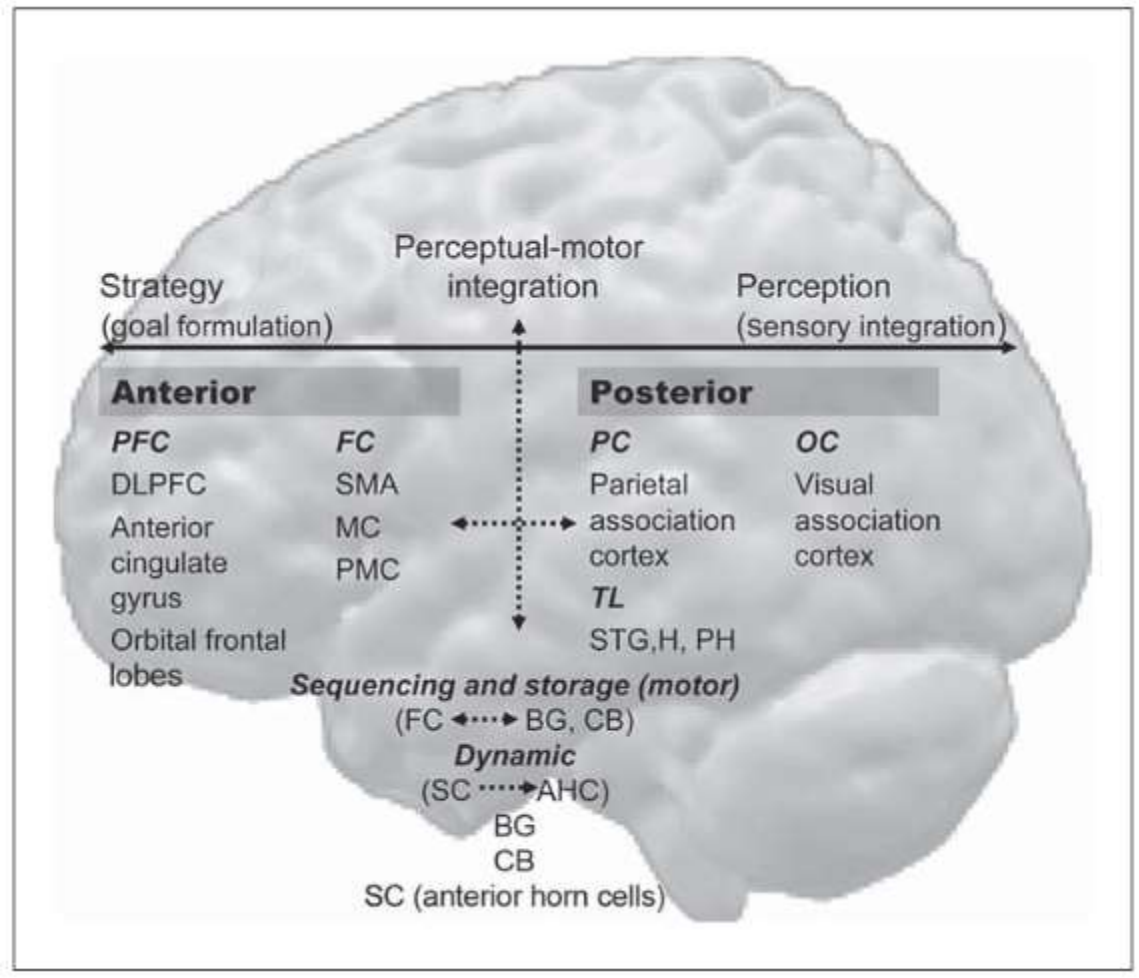


Fig. 1. The hippocampus (H) has a functional relationship with the prefrontal cortex (PFC) through the entorhinal cortex (E) and the nigrostriatal (NS) system. Degeneration of the hippocampus causes a disintegration of visual, vestibular, and proprioceptive sensory and contextual information into spatial maps, leading to gait disturbances. Damage of the prefrontal cortex may cause executive dysfunctions, resulting in gait disturbances. Str: striatum.

•*Scherder et al. Neurosci Biobehav Rev 2007*

Relationship between gait/balance and cognition



•*Sheridan et al. Dement Geriatr Cogn Disord 2007*

Case 1

54-year-old lady was evaluated for loss of recent memory for past 2 years followed by imbalance and recurrent falls for past 1 year. She complains of dizziness while walking and on enquiry, she describes a feeling of 'walking on pillows.' Her imbalance worsened in the evening. and recently she has also noted blurring of vision in both eyes. Examination revealed MoCA score 21/30, normal fundi and cranial nerves, bilateral brisk DTR except ankle jerks, which were lost and positive Romberg's sign.

Case 1

?

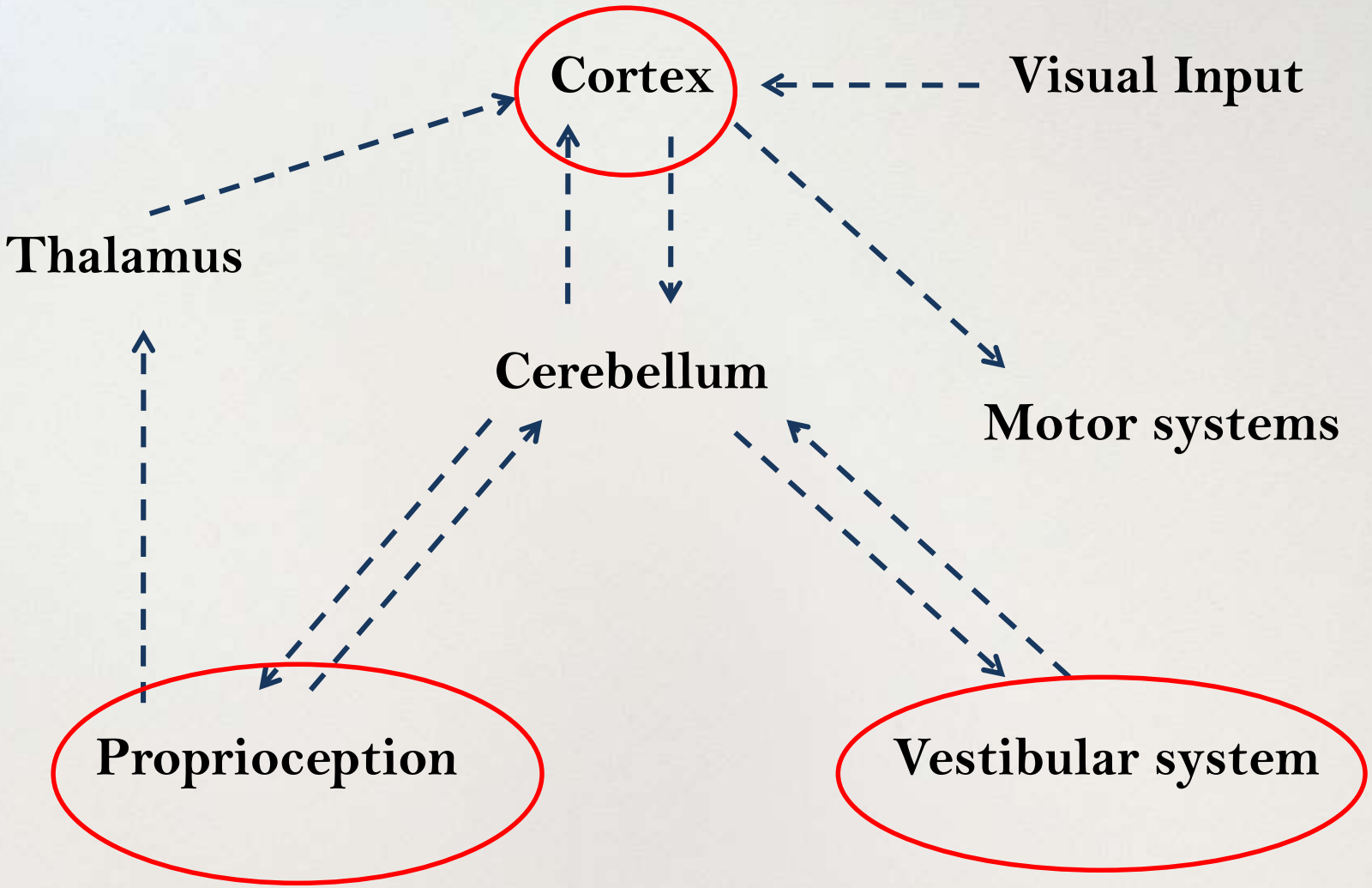
Clue: The patient turned vegetarian 4 years ago.

Case 1

- *Serum vitamin B12: 142 pg/ml*

- *Started on vitamin B12 replacement IM. She is on follow up. Imbalance has partially improved but memory is yet to respond.*

- *P.S. Vitamin B12 deficiency can also cause bilateral vestibulopathy. (Pollak et al, JNNP: 2001: 70)*



(Over) Simplified view of subsystems involved in maintaining balance

Case 2

- *Mr. R, 65-year-old gentleman, was being evaluated in ENT OPD for past 1 year for complaints of chronic dizziness. His symptoms appeared on walking and specially on looking down, for example when he goes down stairs. He has fallen more than once, always backwards.*
- *Mr. R elaborated that he feels blurring of vision when looks down and is unable to maintain balance. His daughter noted that he has become slow during the past year and*

Case 2

He often laughs or cries without provocation.

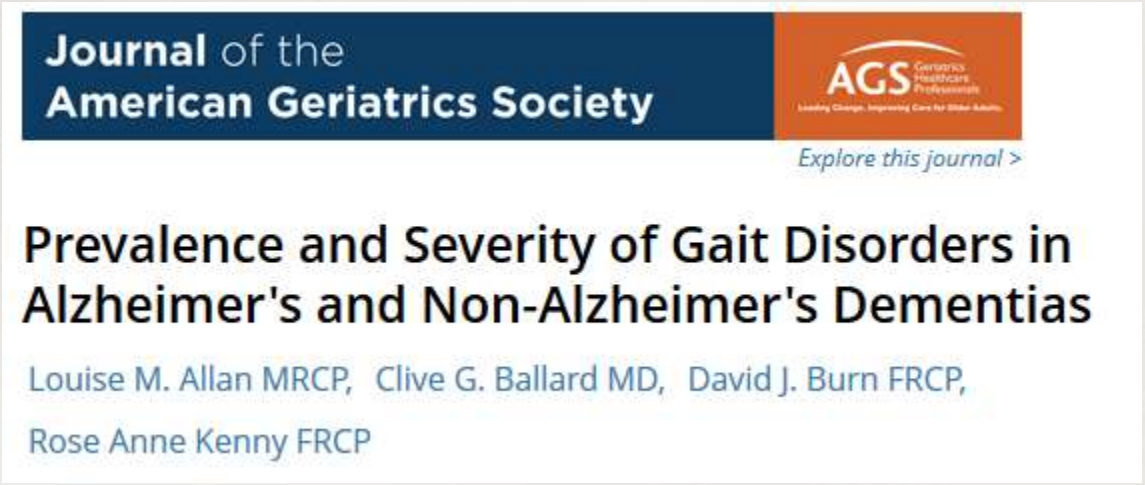
- *Neurological examination revealed vertical gaze palsy, pseudobulbar affect, bradykinesia and positive pull test. MoCA score was 20/30 and FAB score was 8.*
- *His features were consistent with a diagnosis of Progressive Supranuclear Palsy with frontal lobe dysfunction.*

- **Inference: Allowing patients to describe their 'dizziness' pinpoints diagnosis and saves on investigation/medicine expenses.**

Gait and balance disorder in elderly

- 20% of older adults (>65 years) require an aid to ambulate.
- 35% of older adults have an abnormal gait
- ~20% of elderly complained of imbalance or dizziness in the previous 12 months
- In 75% of older adults gait and balance disorders are multifactorial.

- *Salzman. Am Fam Phys 2010*
- *Lin et al.Laryhngoscope 2012*



- N= 245
- Gait and balance was assessed with Tinetti Gait and Balance scale.
- Maximum prevalence of balance disorder was found in PDD (93%), vascular dementia (79%) and DLB (75%)
- In a patient with mild dementia , presence of a gait and balance disorder suggested a non-Alzheimer's dementia (specificity 100%).

Table 3. Associated Signs and Symptoms of Selected Conditions Causing Gait and Balance Disorders

Bradykinesia, rigidity, tremor	Parkinson disease
Chest pain or dyspnea on exertion, palpitations	Arrhythmias, congestive heart failure, coronary artery disease
Cognitive impairment, focal motor or sensory deficits, increased reflexes or tone, unilateral weakness	Stroke, vascular dementia
Cognitive impairment, poor judgment	Alzheimer disease, dementia
Dementia, parkinsonism, urinary incontinence	Normal-pressure hydrocephalus
Dementia, parkinsonism, visual hallucinations	Dementia with Lewy bodies

- *Salzman. Am Fam Phys 2010*

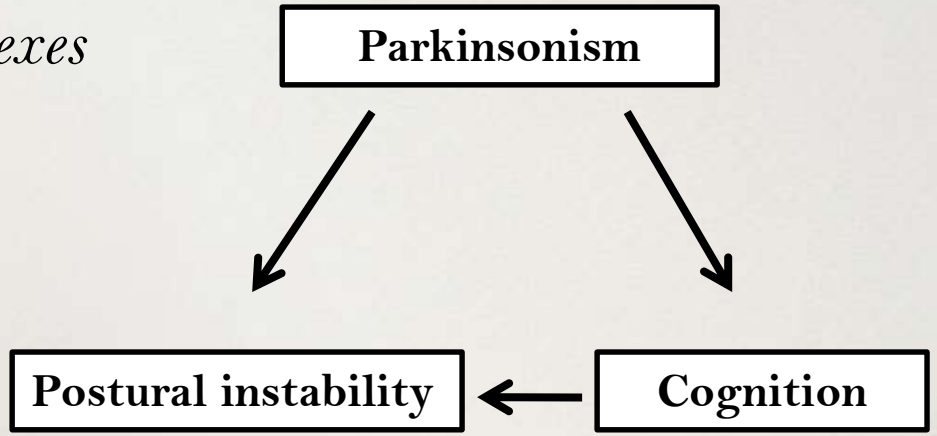
Parkinsonism and imbalance

- *Loss of postural reflex is a diagnostic criteria for parkinsonism*
- *PD has two different motor subtypes- tremor predominant and postural instability gait disorder (PIGD)*
- *PIGD variant has a higher prevalence of postural instability as well as cognitive decline*

- *Burn et al. JNNP 2006*

Parkinsonism and imbalance

- *Factors contributing to imbalance are-*
  - *Cognitive function, particularly attention*
  - *Impaired postural reflexes*
  - *Bradykinesia*
  - *Rigidity*
  - *Sensory dysfunction*
  - *Autonomic dysfunction*



- *Diab et al. Physical Therapy Rev 2014*

Parkinsonism and imbalance

- *Postural instability and cognitive decline in parkinsonism does not respond well to L dopa*
- *An alternative hypothesis suggests cell loss in locus ceruleus and noradrenargic deficit as cause of postural instability*
- *Dynamic posturography is a potential tool to identify 'fallers'*

- *Grimbergen et al. Expert Rev Neurother 2009*
- *Nonnekes et al. Expert Rev Neurother 2013*

Figure 1. Radboud falls simulator.

- *Nonnekes et al. Expert Rev Neurother 2013*

Mild Cognitive impairment

- MCI patients have a lower level of static balance and coordination in comparison to age matched controls.
- These patients also have head instability.
- Amnestic MCI patients are more likely to have balance disorders.

- *Scherder et al. Neurosci Biobehav Rev 2007*

Alzheimer's disease

- 60% patients of Alzheimer's disease have dysequillibrium measured by Tinetti scale
- Associated gait disorders include- gait ignition failure, wide based gait, short stepping gait
- The network for motor control is related to the cognitive networks through DLPFC, parietal association areas, hippocampus and superior tempoal gyrus.

- *O Keefe et al. Age and Ageing 1996*
- *Sheridan et al. Dement Geriatr Cogn Disord 2007*

Alzheimer's disease

- Impairment of motor control and gait stability is associated with impairment of executive function and working memory.
- This can be demonstrated by the dual task paradigms
- Severity of limb apraxia is correlated to gait performance in AD- suggesting that gait apraxia is a significant component

•*Sheridan et al. Dement Geriatr Cogn Disord 2007*

Vascular dementia

CASE 1

Patient 1 initially presented at age 92 years complaining of a gradual deterioration in balance and gait dating back to about age 80 years. She reported "a drunken feeling" when she was on her feet along with a pressure sensation at the top of her head. Her family noted a more recent gradual deterioration in memory and cognitive functions. She fell several times, fracturing an arm and then a hip. Her medical history revealed an abdominal aneurysm repair 10 years earlier and an aortic valve replacement and subclavian artery endarterectomy, performed in the prior year. She never had hypertension. On her

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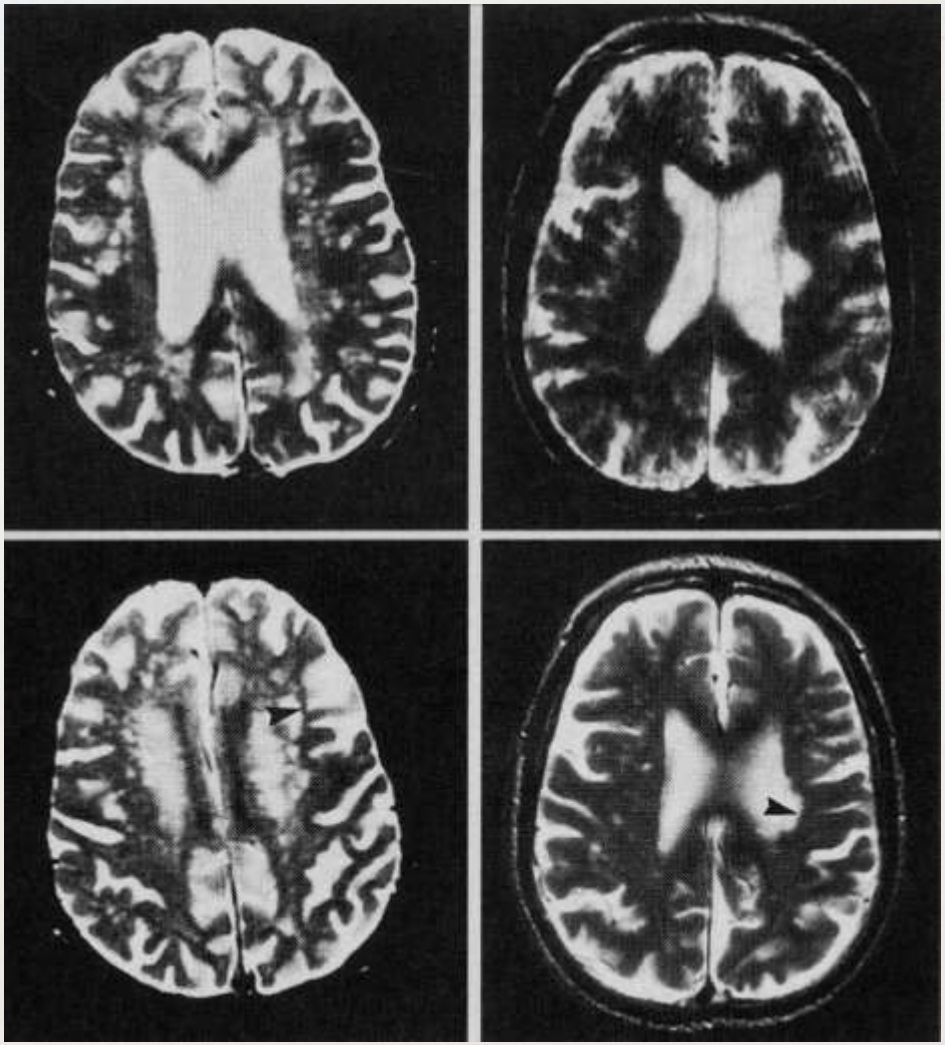
initial examination, she was able to walk with a slightly widened base, taking small slow steps as though her feet were anchored to the floor. She turned en bloc and tended to lose her balance on turns. Mental status examination showed a moderate global dementia. Visual acuity was 20/50 in both eyes and, other than cortical release signs and a modest decrease in vibration sense in the feet, her neurologic examination was unremarkable. Quantitative visual-oculomotor and vestibulo-oculo motor function testing was within normal limits. An MRI scan revealed cortical atrophy, enlarged ventricles, and diffuse periventricular high-intensity signal areas.

Follow-up examinations over the next 3 years documented a progressive deterioration in her balance and gait such that, on the most recent examination before her death, she was unable to stand without assistance and could not take even a single step without support (**Table 1**). She tended to fall backward unless supported. A second MRI scan performed within a month of her death showed further progression of the diffuse periventricular high-intensity signal intensity areas (**Figure 1**, top left and top center).

•*Baloh et al. 1995*

Vascular dementia



- *Baloh et al. 1995*

Vascular dementia

- High risk neurological gait types, like unsteady gait, frontal gait and circumduction gait are at high risk of developing VaD. The patients have a coexisting executive dysfunction.
- Frontal subcortical white matter involvement leads to impaired gait and balance.

- *Verghese et al. J Neural Transm 2007*

NPH

- Classical triad of dementia, urinary incontinence and gait disorder
- Enlarged lateral ventricles distort frontal subcortical white matter
- Increased body sway was documented by posturography

- *Czerowsz et al. Eur J Med Res 2009*

NPH

- In addition, central vestibular pathology is coexistent
- Drainage of fluid improves gait parameters but postural stability may not improve parallely

- *Abram et al. Dement Geriatr Cogn Dis 2016*
- *Lundin F et al. Clin Neurol Neurosurg 2013*

Recommendations for evaluation

SORT: KEY RECOMMENDATIONS FOR PRACTICE

Clinical recommendation	*Evidence rating*	*References*
Gait and balance disorders are usually multifactorial in origin and require a comprehensive assessment to determine contributing factors and targeted interventions.	C	6, 8, 12-14
Older adults should be asked at least annually about falls.	C	4, 27-30
Older adults should be asked about or examined for difficulties with gait and balance at least once.	C	4, 27-30
Older adults who report a fall should be asked about difficulties with gait and balance, and should be observed for any gait or balance dysfunctions.	C	4, 27-30
Exercise and physical therapy can help improve gait and balance disorders in older adults.	B	48, 49, 59-63

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to http://www.aafp.org/afpsort.xml.

- *Salzman. Am Fam Phys 2010*

Recommendations for management

- Multifactorial assessment should be done, which includes-
  - Cognitive impairment
  - Balance disorder
  - Visual symptoms
  - Continence
  - Comorbidities
  - Falls
  - Medication
  - Footwear

- *nice.org.uk*

Bedside assessment

- Tinetti gait and balance scale
- Timed up and go test
- Talking while walking test
- Pull test
- Functional reach test
- Observation of gait

Recommendations for management

- Multifactorial intervention-
  - Strength and balance training
  - Home hazard assessment and intervention
  - Vision assessment
  - Medication review
- Rivastigmine (ReSPonD): improves gait stability and reduces fall risk

- *nice.org.uk*
- *Henderson et al. Lancet Neurol 2016*

Recent developments

- Kinect based home balance rehabilitation
- Multi-sensory balance training
- Augmented reality programs
- Tai chi
- Balance enhancing insoles
- Vibrotactile device

- *Alrwaily et al. 2011*

Summary

- Prevalence of gait and balance disorders in dementia patients is high
- PDD, VaD, NPH are more likely to be associated with postural instability
- The balance disorder is often multifactorial
- It recommended to screen for balance disorders in the elderly population
- Rivastigmine is helpful in certain groups
- Non-pharmacological management is cornerstone- new technologies are evolving

THANK YOU