Gait disorders in clinical practice

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handout

additional videos and photos will be shown in the presentation

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Disorders of gait and balance:
basic definitions

Bipedal walking: evolutional human motor skill, parallels the development of the frontal lobe

- **Balance:** the ability to stand up and remain upright against the force of gravity (equilibrium)
- **Locomotion:** rhythmic stepping movements to advance in space (gait)
- **Adaptability** to the environment

Disorders of gait and balance:

- among the most common problems in neurologic patients
- increasing prevalence with age
- limit QoL, most serious consequence: **Falls**

Disorders of gait and balance: clinical examination

History of gait and balance disorders

- quality of gait, activity levels, walking perimeter
- falls (frequency, circumstances, direction)

Associated symptoms and signs

- dizziness, urinary symptoms
- other neurologic or systemic symptoms
- depression, cognitive dysfunction

Testing of balance and gait

- simple observation
- gait/balance tasks
- questionnaires and scales
- laboratory measurement of gait parameters

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Basic patterns of gait disorders

parameter affected		*abnormal pattern of gait*
muscle strength	↓	weakness: paretic gait
base width	↑	broad base: ataxic gait
stride length	↓	stiff gait
cadence of stepping	↕	
fluidity of movement	↓	
gait initiation and maintenance	↓	freezing of gait
unclassifiable	~	„bizarre“ gaits

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Classification of gait disorders

phenomenologic
(patterns of gait)

- antalgic
- weakness
- ataxic
- stiff
- freezing
- „bizarre“

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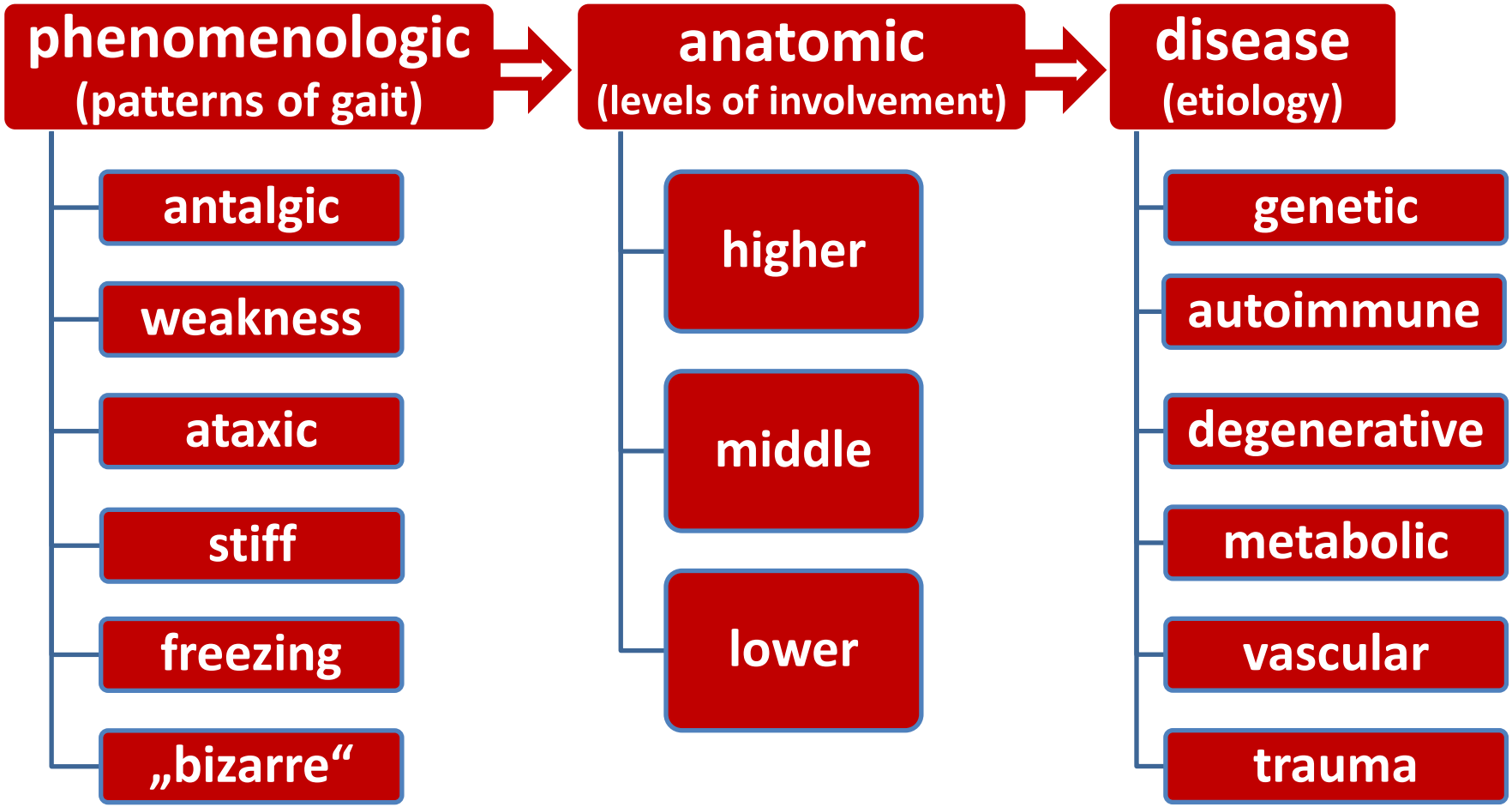
Classification of gait disorders



Nutt 1993, Verghese 2006, Snijders 2007, Giladi 2013, ...

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Classification of gait disorders:
anatomic levels

Level	*Anatomic*	*Functional subsystem*
Higher	cortex	cognition, attention, insight (conscious)
	subcortical white matter	synergy selection and adaptation to circumstances (unconscious)
Middle	basal ganglia	perception/orientation (body spatial maps)
	thalamus	
	cerebellum	force scaling (modulation of motor patterns)
	brainstem	
	spinal cord tracts	
Lower	periph. sensory nerve	locomotor synergies
	lower motor neuron	primary afferent input
	muscle and nm junction	force production

Nutt 2001, adapted

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Anatomo-clinical classification

Lower level disorders of gait

myopathies

neuropathies and radiculopathies

lower motor neuron disease

sensory disorders

- visual
- vestibular
- proprioceptive

bilateral peroneal neuropathy

distal weakness, foot drop, steppage

Anatomo-clinical classification

Middle level gait disorders

parkinsonian (hypokinetic)

- + PIGD phenotype

dyskinetic

- chorea
- dystonia
- myoclonus
- tics

cerebellar (ataxic)

corticospinal (spastic)

- hemiparetic
- paraparetic

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Anatomo-clinical classification

Middle level gait disorders

parkinsonian (hypokinetic)

short steps

shuffling

festination

slow turning

flexed posture

reduced arm swing

Parkinson disease – early onset

Anatomo-clinical classification

Middle level gait disorders

Parkinson disease – late onset

parkinsonian (hypokinetic)

- **PIGD phenotype**

predominant involvement of posture and gait

poor response to treatment

high risk of dementia

frequent falls and injuries

Gait disorders and falls are major problems in late stage PD

- **start hesitation in 90%, freezing in 81% pats.**
- **falls in 81% pats. (mean onset at 11.5 years)** ***Hely 2005***

Anatomo-clinical classification

Middle level gait disorders

Huntington‘s disease

dyskinetic

- **chorea**
- dystonia
- myoclonus
- tics

dyskinesia interfering with gait

broad base

variable stride length and cadence

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Anatomo-clinical classification

Middle level gait disorders

multiple sclerosis

cerebellar (ataxic)

BROAD BASED GAIT

instability

freely-flowing unsteady steps

erratic variance in rhythm and amplitude

action tremor + titubation

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Anatomo-clinical classification

Middle level gait disorders

cerebral palsy

corticospinal (spastic)

- hemiparetic
- paraparetic

STIFF GAIT

spasticity
circumduction, scissoring

Anatomo-clinical classification

Higher level gait disorders

1) **Freezing of gait (FOG)**
   - **FOG in PD**
   - **primary progressive freezing of gait**
2) **Frontal (apraxia of) gait**
   - **cautious gait, senile gait, lower body parkinsonism, gait apraxia, …**
   - **combining signs of ataxia, parkinsonism, FOG**
   - **bilateral involvement of frontal lobes = cortical-basal ganglia-thalamo-cortical loops**

Higher level gait disorders

FOG in Parkinson disease

FOG leads to falls

FOG + STIFF GAIT

start hesitation
sudden stops
motor blocks
sensory tricks

common cause of falls in PD

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Higher level gait disorders

FOG in Parkinson disease

effect of sensory tricks

external pacing cues (including emotions)

triggering alternative motor programs

helpful in rehabilitation

Higher level gait disorders

Primary progressive FOG

FOG more common in APS than in PD: 53% of PSP, 54% MSA, 54% DLB, 25% CBD

50% of vascular parkinsonism cases

FOG is associated with executive dysfunction

Syndromes dominated by FOG: „gait ignition failure, pure akinesia, primary progressive freezing of gait“

Atchison 1993, Achiron 1993, Factor 2002, Giladi 2007, Barone 2008

Higher level gait disorders
Frontal (apraxia of) gait

1) Freezing of gait (FOG)
   - FOG in PD
   - primary progressive freezing of gait

2) **Frontal (apraxia of) gait**
   - **cautious gait, senile gait, lower body parkinsonism, gait apraxia, …**
   - **combining signs of ataxia, parkinsonism, FOG**
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Higher level gait disorders

Frontal gait

- increased variability of gait parameters, greatly influenced by the environment and emotion
- narrow or widened base
- stooped or upright posture with flexed hips or knees
- reduced gait speed and stride length
- often associated with FOG, hypokinesia/rigidity, frontal release signs, cognitive deficits - executive dysfunction
- absent or inappropriate rescue reactions, often falls and/or fear of falling
- various etiologies: arteriosclerotic encephalopathy („vascular parkinsonism“), normal pressure hydrocephalus, etc.

Higher level gait disorders

Frontal gait

FRONTAL GAIT + FOG

- **broad base, instability**
- **fear of falling**
- **freezing of gait**
- **hypokinetic gait**
- **incontinence**
- **cognitive dysfunction**

normal pressure hydrocephalus

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Higher level gait disorders

Frontal gait

„VASCULAR PARKINSONISM“

- **hypokinetic gait**
- **FOG**
- **preserved arm swing**
- **no hypokinesia of hands and feet**
- **no effect of L-DOPA**

subcortical arteriosclerotic encephalopathy

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Falls

- causes and mechanisms (careful history taking!)
  - relative to the primary disease
    - postural instability (e.g. as part of PD symptoms)
    - freezing + (retro)pulsion
    - orthostatic hypotension
  - unspecific causes, comorbidity in the elderly
    - astasia-abasia
    - impairment of vision
    - cardiogenic syncopes
- prevention
  - modifications in the environment and regime
  - physical activity, physiotherapy, mechanical devices

Summary

DISORDERS OF GAIT AND FALLS

- are common in neurologic patients and in the elderly
- substantially limit quality of life

OBSERVATION

- key approach to diagnosis of gait disorders

PHENOMENOLOGIC CLASSIFICATION

- to distinguish basic patterns of abnormal gait
- always consider compensation - fall risk - cognitive dysfunction - continuous vs. episodic disorder

SYSTEM (ANATOMIC) CLASSIFICATION

- lower – middle – higher level gait disorders
- to understand pathophysiology and to recognize etiology

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