Evaluation of gait and balance

Presented by Joanna O’Leary, MD
Co-director of Providence Neurological Specialties Movement Disorder Department
Gait and balance

• Complex

• Requires integrity of:
  • Lower level:
    • Sensory input - e.g. vision, touch
    • Motor output - muscle strength, joints
  • Intermediate level:
    • Ability to hit target, maintain rhythm, coordinate vision and movement, etc
  • Higher level:
    • Ability to respond to obstacles and plan
Pertinent elements of history

- Duration
- Frequency
- Onset
- Progression
- Falls (details)
- Walking Aids
- Weakness
- Numbness
- Back/neck pain
- Urinary incontinence
- Bowel symptoms
- Tremor
- Incoordination
- Stiffness
- Seizures
- Syncope
- Orthopedic conditions
- Prior strokes
- Other neurological diseases
- Psychiatric meds
- Alcohol/illicit drugs
How to assess gait

• Evaluate general neurological condition:
  • Ask about orthopedic conditions
  • Sensation and vision abnormalities
  • Dementia

• Consider compensations
  • Is patient in pain?
  • Are they scared to fall?
  • Are they unaware of their deficits?
How to assess gait

• Consider limb impairment
  • Evaluate for limb weakness, tone, reflexes, abnormal movements

• Analyze step height, width, length and rhythm

• Look for specific gait abnormalities:
  • Freezing
  • Festination
  • Scissoring
  • Drop foot
Ways to classify gait

• Heirarchical:
  • based upon lower, intermediate and higher levels of impairment

• Anatomic:
  • Based upon region of nervous system affected

• Phenomenologic:
  • Based upon description of gait

• Pathophysiologic
  • Based upon type of disease

• In practice: pathophysiology is preferred, but sometimes phenomenologic descriptions are necessary
Parkinson’s disease gait

• Amplitude reduction
  • Small step length, slowed gait
• Reduced step height
• Reduction in arm swing
• Step length asymmetry
• Increased cadence (number of steps taken)

• Freezing of gait - difficulty initiating gait
• En bloc turns
• Kyphosis
• Difficulty standing from seated position
Parkinson’s disease gait
Lower body Parkinsonian gaits

• Higher-level gait disorder
  • associated with frontal lobe dysfunction - planning, navigation

• Vascular parkinsonism
  • Associated with strokes involving the basal ganglia or diffuse white matter disease changes
  • External rotation of legs and wider base

• Normal pressure hydrocephalus
  • Ventriculomegaly
  • Gait impairment plus urinary incontinence and/or cognitive impairment
  • MRI CSF flow, large volume LP
Vascular Parkinsonism
Vascular parkinsonism
Normal pressure hydrocephalus

Evan’s ratio
> 31%
Frontal horn/Int skull

Callosal angle
< 100 degree
Angle lat vent at post commis

Ventriculoperitoneal Shunt Placement for Normal Pressure Hydrocephalus
Choreic/Dyskinetic gait

• Associated disorders:
  • Huntington’s
  • Tardive dyskinesia
  • Dyskinesia related to Parkinson’s disease

• Slowed gait, increased variability in step length, irregular/erratic movements
Dyskinetic and Stiff Gait

Dyskinetic and stiff gait in a patient with Parkinson disease experiencing disabling levodopa-induced dyskinesia. Note the dystonic features of the left lower limb.
Ataxia

• Impaired coordination of voluntary muscle movement
• Physical finding, not a disease
• Causes:
  • Cerebellar disorder (genetic or acquired)
  • Impaired vestibular input
  • Impaired proprioceptive input (dorsal column, sensory nerves)
Features associated with ataxia

• Wide stance
• Unstable gait
• Dysdiadokinesia
  • impairment of rapidly alternating movements
• Intention tremor
  • Increased amplitude of oscillation when trying to hit target
• Dysmetria
  • Miss target due to overshoot
Features associated with ataxia

• Dysarthric speech
• Nystagmus
• Ocular dysmetria
  • Saccades over or undershoot target
• Sensory and vestibular ataxia features:
  • Balance worse in the dark
  • Positive Romberg
Ataxic gait in a patient with alcoholic ataxia. Note the wide base of support and feet dysmetria during stepping.
Spastic gait/hemiparetic gait

- Due to lesion of the corticospinal tract
  - Efferent nerves from cerebral cortex to spinal cord
  - Lesions in brain, brainstem or spinal cord
- Bilateral - scissoring gait
- Unilateral - hemiparetic gait
- Associated features:
  - Leg extension and foot plantarflexion
  - Hip circumduction
  - Spasticity - rate dependent increased tone
  - Hyperreflexia, clonus, Babinski
Hemiparetic gait

Hemiparetic Gait
Hemiparetic gait in a patient with left-hemisphere stroke.
Note lower limb circumduction.
Scissoring gait

Scissoring Gait
Scissoring gait in a patient with secondary dystonia due to juvenile cerebral palsy.
Psychogenic gait

- Gait is not typical for known neurological disorders
- Inconsistent pattern
- Distractible
  - E.g. Romberg positive except when patient is distracted
Psychogenic gait

Sudden Buckling of the Knees in Functional/Psychogenic Gait

Note the inconsistency and variability of the disorder over time.
Other gait types

• Antalgic - pain
• Cautious - fear
• Trendelenburg gait
  • gluteal muscle weakness
  • Hip instability
• Waddling - proximal weakness
Name that abnormal gait - Case 1

• CC: imbalance
• 65 yo woman with history of fall 4 years ago with possible head trauma and rhabdomyolysis. Continued unstable gait and diplopia since then.
• PMHx/Meds/SHx/FHx - not pertinent
Name that abnormal gait - Case 1
Name that abnormal gait - Case 2

• CC: unstable gait and neck forward flexion
• 82 yo woman with onset of imbalance and neck starting 2 years ago
• PMHx: breast cancer
• Meds/FHx/SHx: not pertinent
Name that abnormal gait - Case 2
I’m still trying to figure this one out - waiting for imaging . . . .

- Progressive unstable gait, urinary incontinence, and cognitive impairment
I’m still trying to figure this one out - waiting for imaging . . . .
Thanks again to my wonderful patients for letting me film them!!

References: