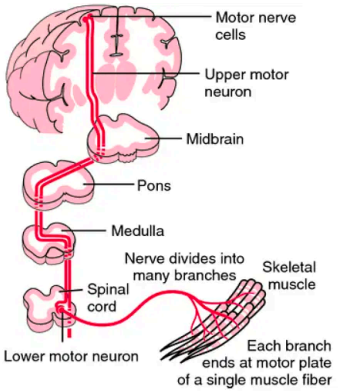
Neurological Approach

In Long Case Examination

Wisan Teeratantikanon, MD, FRCP(T)

Neurology Unit, Maharat Nakhon Ratchasima Hospital

UMN vs LMN Signs



	UMNL	LMNL
Lesion	Above the anterior horn cell in the spinal cord or above the nuclei of the cranial nerves	Anterior horn cell, motor nerve fibre or neuromuscular junction
Tone	Increased (spasticity) ± clonus	Reduced
Muscle weakness	All muscle groups of the lower limb – more marked in the flexor muscles. In the upper limb weakness is more marked in the extensors	More distally than proximally. Both flexors and extensors affected
Deep tendon reflexes	Increased (but superficial reflexes such as abdominal reflexes are usually absent)	Reduced or absent
Plantar response	Extensor (upgoing toe)	Normal or absent
Fasciculation	Absent	May be present in anterior horn cell lesions
Wasting	Late; mainly because of disuse	Usually present

Approach to weakness

Type	Lesion	Example	Motor	Sensory	Reflex / tone	BBK	Wasting
UMN	**Brain**	Stroke, tumor	Hemiparesis	If involved sensory fiber	↑	+	No (early)
	Spinal cord	Myelopathy	Para/Quad	Sensory level	↑ below	+	No (early)
LMN	**Anterior horn**	ALS, Kennedy's	Mixed	Normal	Mixed	±	Yes
	Nerve root	Radiculopathy	Myotomal	Dermatomal sensory loss	↓	-	±
	Peripheral nerve	DM, GBS, CIDP	Distal>prox	Impaired	↓	-	Mild
	NMJ	MG, LEMS	Ocular, Prox	Normal	Normal/↓	-	No
	Muscle	Myositis	Prox>dist	Normal	Normal/↓	-	Yes

Outline

- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

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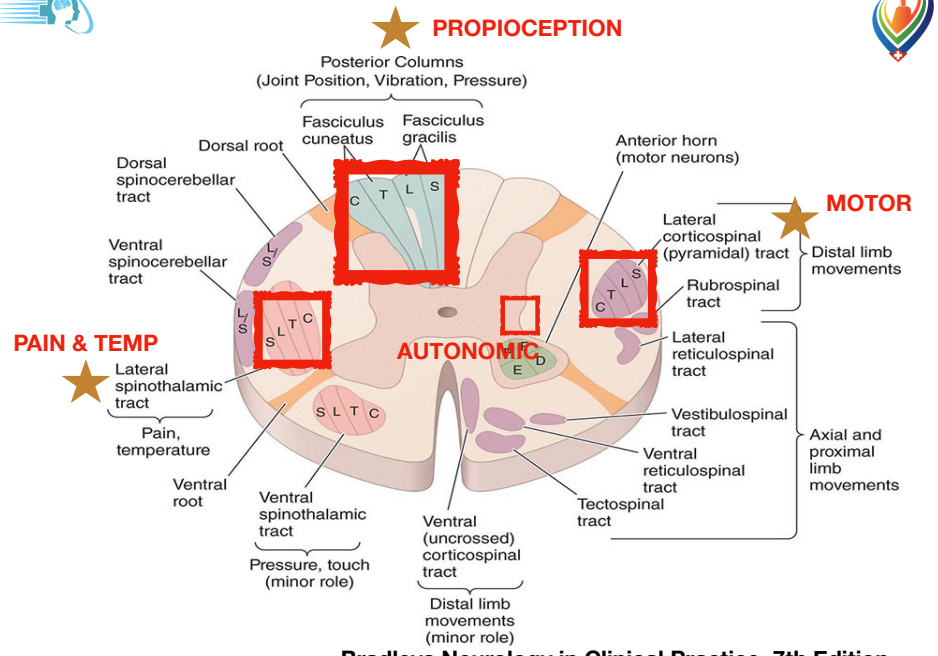
Paraparesis

- Localization
  - **Spinal cord**
  - Parasagital area
  - Proximal myopathy?



Bradleys Neurology in Clinical Practice, 7th Edition.

Myelopathy
Extrinsic vs. Intrinsic cord

	Extrinsic cord	Intrinsic cord
Pain	Radicular pain (dermatome)	Funicular pain (ill-defined)
Bone pain	Vertebral pain	-
Sensory	Ascending (sensory level)	Descending, hanging, cape-like
Saddle	Saddle or perineal numbness	Sacral sparing
Motor	Ascending	Descending
Autonomic	Late	Early
LMN sign	-	Widespread with atrophy
UMN sign	Early pyramidal	Late

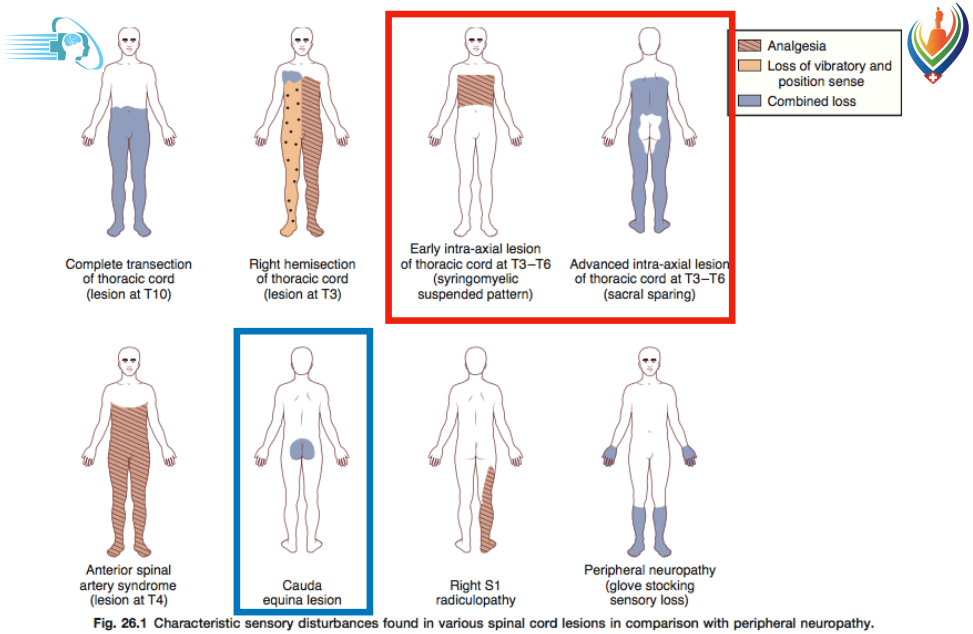
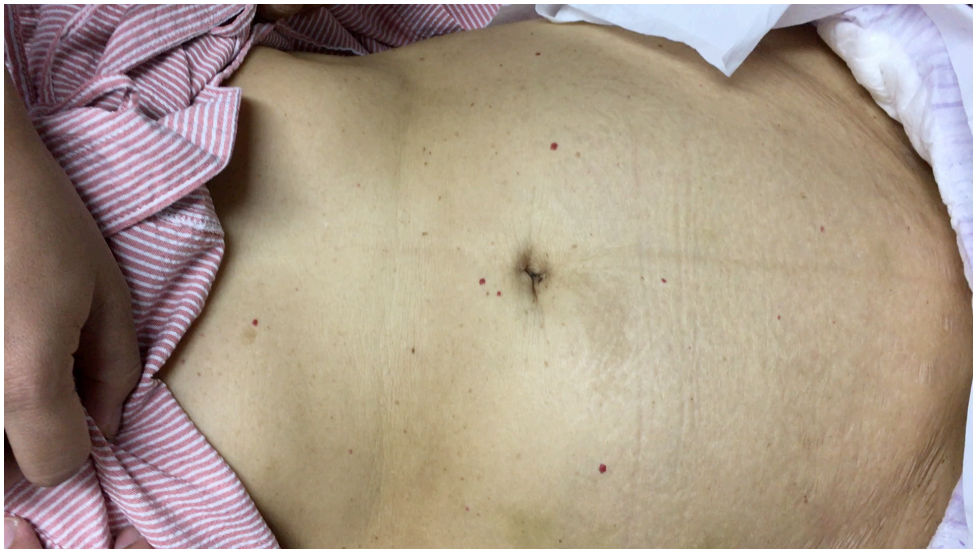


Fig. 26.1 Characteristic sensory disturbances found in various spinal cord lesions in comparison with peripheral neuropathy.

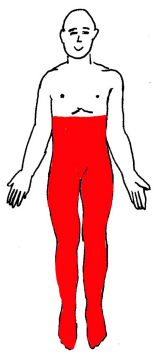
Bradleys Neurology in Clinical Practice, 7th Edition.

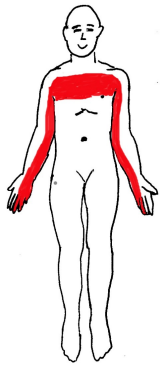
Beevor's sign



Common causes

Extrinsic cord	Intrinsic cord
Infection (Bacteria/TB) • Spondylodiscitis • Epidural abscess	Transverse myelitis
Tumor • Metastasis (Solid/ Hematologic) • Primary (meningioma, NF)	Syringomyelia
Degenerative	Tumor (astrocytoma, ependymoma)
Epidural Hematoma	Cord Ischemia
Other: gout tophi	HSP





Common causes

Myelitis DDx
- **MS/ NMO**
- **SLE, MCTD, SS, Behcets**
- **Sarcoidosis**
- **Post viral or bacterial eg. TB**

Rx: IVMP in acute attack

Extrinsic cord	Intrinsic cord
Infection (Bacteria/TB) • Spondylodiscitis • Epidural abscess	Transverse myelitis
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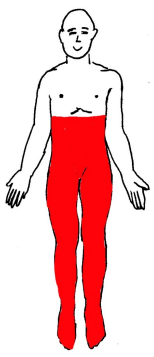
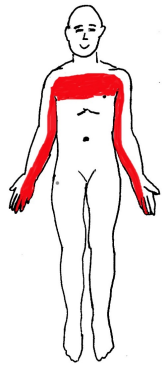
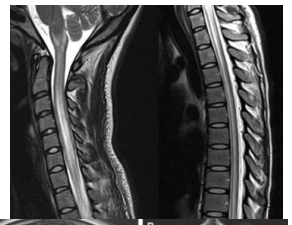




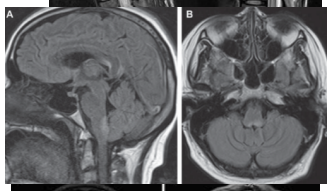
NMO

NMO

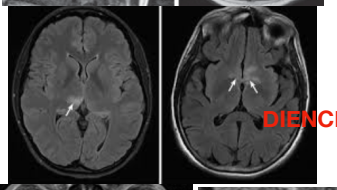
- Immune demyelination
  - **ATM** (Long-extensive TM >=3 cords)
  - **ON**
  - **Area postrema**: hiccups or N/V
  - **Brainstem** syndrome
  - **Cerebral**
  - **Diencephalic**
- Ix: MRI, **Serum NMO IgG or AQP4-IgG**
- **Rx:**
  - Attack: **IVMP** if not response or severe —> **PLEx**
  - **Long term (at least 5 year)**: attack prevention: immunosuppressant: **Aza, MMF, RTX**



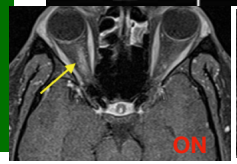
LETM



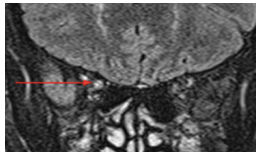
AP

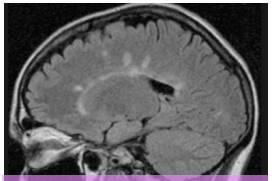


DIENCEPHALON

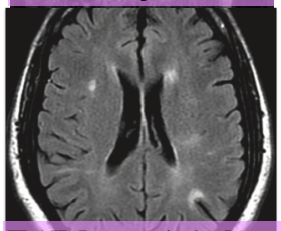


ON

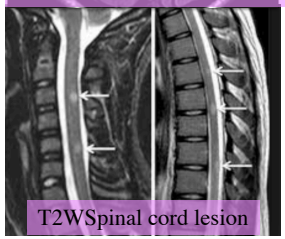




FLAIR PV : Dawson's finger



FLAIR Paraventricular Juxtacortical

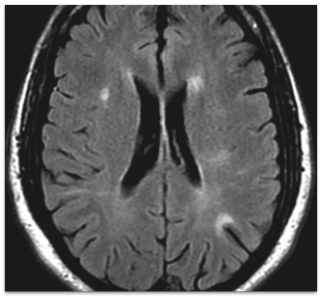


T2WSpinal cord lesion

MS

- MS
  - DIS
    - ~~ON~~
    - ATM
    - Periventricular
    - Juxtacortical/ cortical
    - Infratentorial
  - DIT
    - >1 episodes
    - CSF OCB
  - Rx
    - IVMP or PLEX if not response
    - DMT: IFN-B, Fingolimod, glatiramer, natalizumab, dimethyl fumarate

Typical MRI of MS lesion



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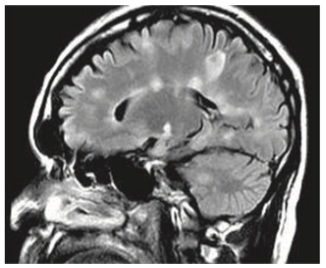

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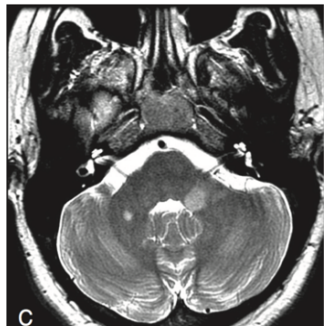
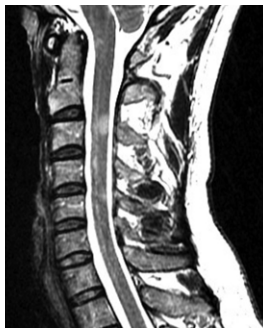


T2W Infartentorial



T2WSpinal cord lesion

Bradley's Neurology in Clinical Practice 7 edition

	NMOSD	MS
ATM	• Longitudinally extensive lesion (>=3 vertebral segments) • Central/gray matter involvement	• Short, often multiple lesions • Peripheral/asymmetrical/often posterior
ON	• Long-length/posterior-chiasmal lesions • More severe	• Short-length lesions
Brain	• Periependymal lesions • Diencephalon • Area postrema	• Dawson fingers • S-shaped U-fiber

Common causes

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- MS/ NMO
- SLE, MCTD, SS, Behcets
- Sarcoidosis
- Post viral or bacterial infections

Rx: IVMP in acute attack

Extrinsic cord	Intrinsic cord
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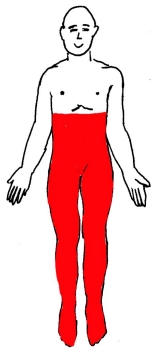
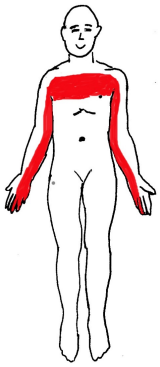
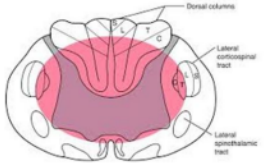
	HSP

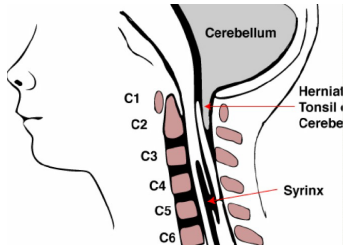


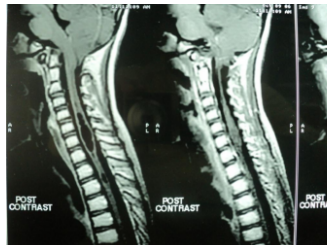


Syringomyelia

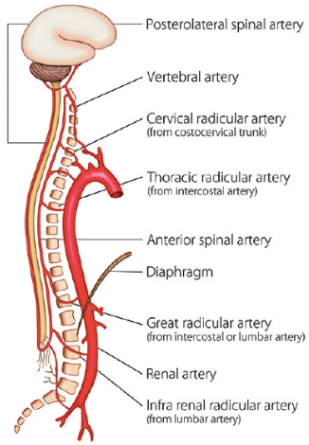
- Expansion of central canal, cervical is most common
- Central cord syndrome
  - Chronic bilateral arms weakness and numbness, atrophy
  - Lower limbs hyperreflexia
- Etiology: Chiari malformation, Posttraumatic, Post spinal Sx
- DDx with CSM/CSR, MND

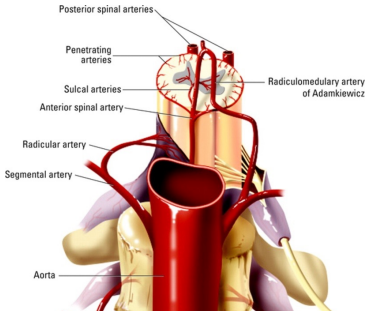






Spinal cord ischemia





- Anterior cord syndrome is most common
- Clinical
  - Spare posterior column (proprioception)
  - Water shed area = mid T level (T4-T8)
- Cause
  - Vascular surgery with descending aorta involvement eg. AAA Sx, TEVAR
  - Shock

Paraparesis

- Localization
  - Spinal cord
  - Parasagital area
  - Proximal myopathy?

Rare, may be asymmetry

Acute headache, Seizure, Stroke-like, hypercoagulability

- Superior sagital sinus thrombosis
- Parasagital meningioma
- Bilateral ACA infarction

Slowly progressive paraparesis

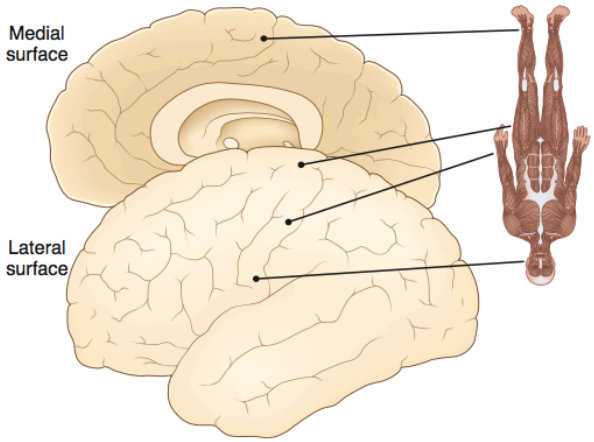


Fig. 25.1 Representation of the body on the motor cortex. Face and arms are represented laterally, and legs are represented medially, with cortical representation of the distal legs bordering on the central sulcus.

Outline

- **Problems**
  - Paraparesis
  - **Ataxia**
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Ataxia

- Acute or chronic
  - Sensory ataxia
  - Cerebellar ataxia
  - Frontal ataxia

Must be rule out

- Visual: diplopia, ptosis, VF, VA
- Vestibular: Position related, vertigo, tinnitus, HL
- Motor: weakness, abnormal movement (parkinsonism,…)
- Cerebellar — Cerebellar sign, GEN, vertical nystagmus, scanning speech, intention tremor, overshoot, pendulum, wide-based, tandem, FTN-HTK
- Sensory — Propioception and VBS = worsen in dark, better in rough route
- Higher gait — Wide-based, magnetic, freezing, short, shuffling gait

Ataxia

Feature	Cerebellar	Sensory	Frontal
Posture	Leans forward	Stooped	upright
Stance	Wide-based	Wide-based	Wide-based
Initiation	N	N	Start hesitation
Step	Staggering	High-stepping	Short, shuffling, magnetic
Speed	N	N	Very slow
Tandem	Unable	N	Unable
Rhomberg	N	Positive	N
HTK	Abnormal	N	N
Falls	N	Yes	Very common

Ataxia

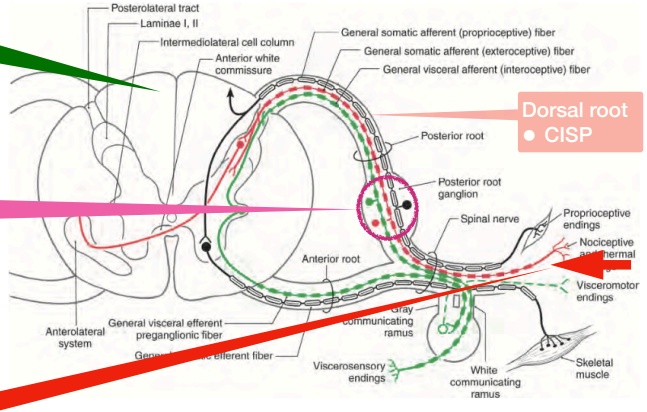
- Acute or chronic
  - Sensory ataxia
  - Cerebellar ataxia
  - Frontal ataxia

Sensory ataxia

Posterior Column
- B12 def
- Tabes dorsalis

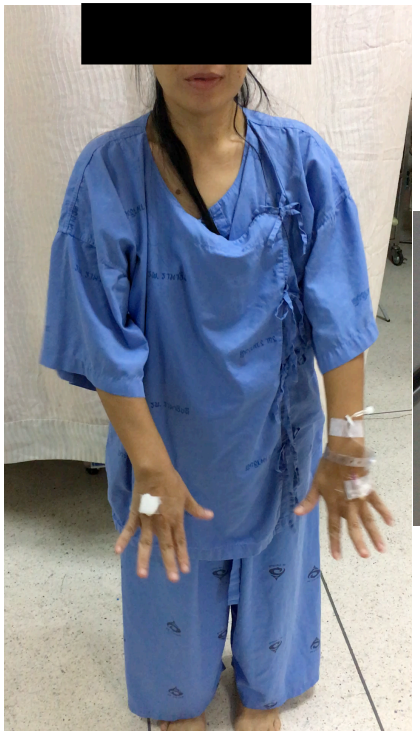
Neuronopathy (DRG)
- Paraneoplastic eg. Anti-Hu
- Sjogren syndrome
- Toxic (Cisplatin, B6excess)

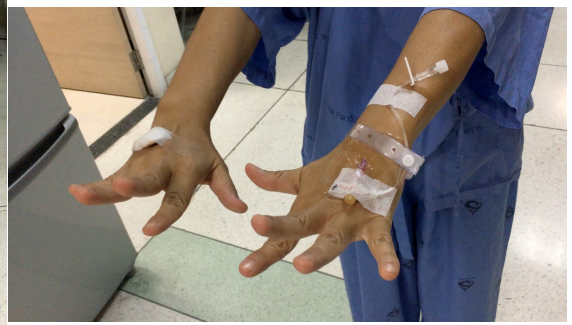
Neuropathy (nerve)
- Sensory CIDP
- MFS



Dorsal root
- CISP

Triad: Opthalmoplegia, ataxia (both cerebellar and polyneuropathy), areflexia

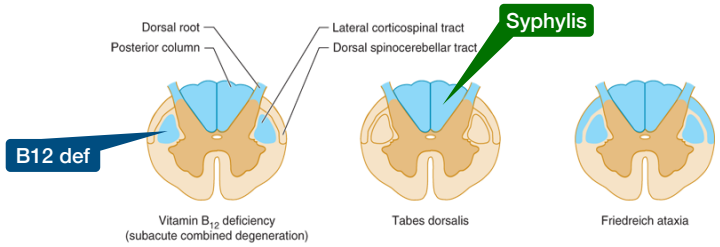




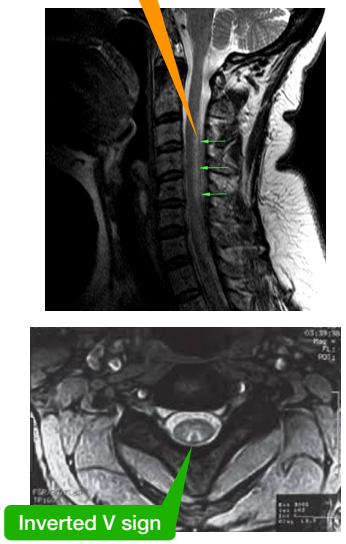
Sensory ganglionopathy from SS (Neuronopathy)
+ve Pseudoathetosis

Posterior cord syndrome

- Presentation: impair vibration and fine touch and pyramidal tract sign
- DDx
  - SCD: B12 def, Cu def, Zn toxicity (cause Cu def)
  - Friedreich's ataxia: AR, >50% hereditary ataxia, mutation FRDA, chrmosome9, progressive limb and gait ataxia, dysarthria, absent DTR at legs and extensor response to BBK
  - Syphilis - Tabes dorsalis
  - HIV : vacuolar myelopathy



Subacute combine degeneration



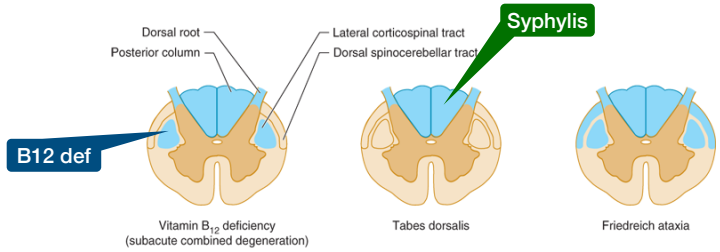
- Posterior column = VBS, ataxia
- Lateral column (corticospinal tract) = weakness, spastic paresis
- Others: dementia, peripheral neuropathy, megaloblastic anemia

- Causes
  - B12 deficiency: Pernicious anemia, Crohn's dz, GI surgery
- Ix: Serum B12, Malonic acid, Methylmalonic acid, Schilling test, CBC, MRI: hyperT2 at posterior column
- Rx: B12 IM OD x 1wk then weekly for 1 month then monthly lifelong

Tabes dorsalis

- SS
  - Posterior column (sensory ataxia) and dorsal root (lacinating pain), latent period 3-20 y
  - Not commonly involve lateral column
  - Argyll-Robertson pupil
    - small, not react to light but react to accommodation
  - Dementia, visual impairment
- Absent lower extremities reflex
- CSF: may be normal or mild LC pleocytosis with 10-50

disease of the posterior columns and dorsal roots



Ataxia

- Acute or chronic
  - Sensory ataxia
  - Cerebellar ataxia
  - Frontal ataxia

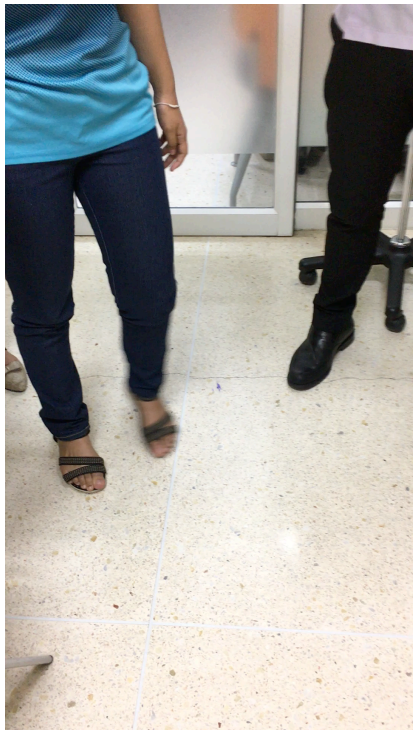
Cerebellar ataxia

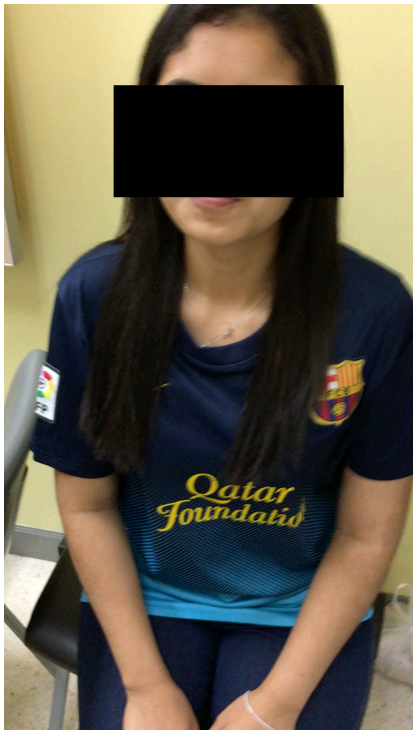
Acquired
- Mostly acute/subacute
- Any age
- No FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

Inherited
- Chronic
- Age<50
- FHx

- AD
  - SCA
  - EA
- AR
  - Ataxia telangiectasia (AT)
  - Friedreich's ataxia
- XR
- Mitochondrial dz





Cerebellar ataxia

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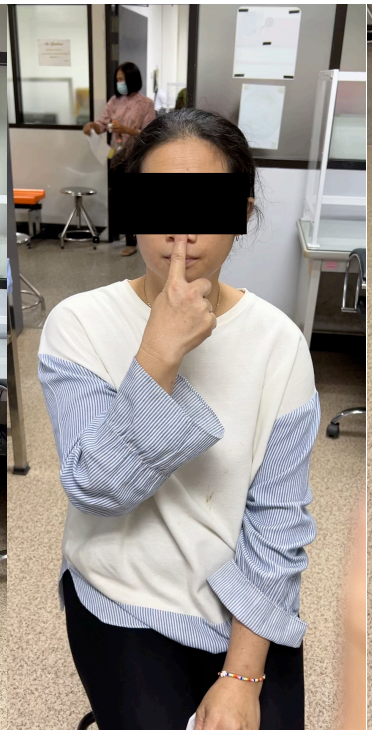
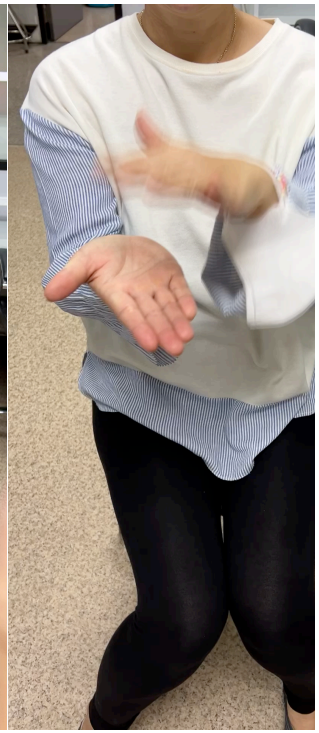
- Mostly acute/subacute
- Any age
- No FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

Inherited
- Chronic
- Age<50
- FHx

- AD
  - SCA
  - EA
- AR
  - Ataxia telangiectasia (AT)
  - Friedreich's ataxia
- XR
- Mitochondrial dz





Cerebellar ataxia

Acquired
- Mostly acute/subacute
- Any age
- No FHx

Inherited
- Chronic
- Age<50
- FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

Cerebellar ataxia

Acquired
- Mostly acute/subacute
- Any age
- No FHx

Inherited
- Chronic
- Age<50
- FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

- Alcohol
- Dilantin
- Ara-C
- Thalium
- 5-FU
- Amiodarone
- B12def (cerebellar and sensory ataxia)

- Alcoholic cerebellar degeneration (ACD)
  - Direct toxic and B1def
  - subacute to chronic
  - trunk and gait
  - Vermis atrophy
- Wernicke's encephalopathy
  - B1def
  - acute to subacute
  - Triad
    - Encephalopathy
    - Ophthalmoparesis
    - Ataxia

Cerebellar ataxia

Acquired
- Mostly acute/subacute
- Any age
- No FHx

Inherited
- Chronic
- Age<50
- FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

- Acute: EBV, VZV
- Chronic
  - HIV OI
    - Toxo abscess
    - TB: tuberculoma, TB vasculitis
    - Cryptococcoma
  - sCJD (myoclonus + ataxia)
  - Post infectious cerebellitis

Cerebellar ataxia

Acquired
- Mostly acute/subacute
- Any age
- No FHx

Inherited
- Chronic
- Age<50
- FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

Paraneoplastic Cerebellar Degeneration (PCD)

- Tumor
  - SCLCA: anti-Hu, Anti-Ri. Anti-CV2, Anti-VGCC
  - CA breast and CA ovary: Anti-Yo
  - HD: Anti-Tr
- Subacute <12wk
- Before or after Dx tumor
- Inferior olive degeneration

- PCD = Difficult to Rx, poor response to Rx
- Rx
  - Rx primary tumor
  - PE, IVIG, steroid
  - Screening cancer - CT chest+WA/ MRI/ PET q 3-6 mo until 2 year

Cerebellar ataxia

Acquired
- Mostly acute/subacute
- Any age
- No FHx

Inherited
- Chronic
- Age<50
- FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Neurodegeneration

Autoimmune mediated cerebellar ataxia

Anti-GAD syndrome
- Anti-GAD-65 in blood or CSF
- <5% related cancer
- SS
  - T1DM, Stiff-person syndrome, seizure, cognitive impairment
- Rx: IVIG, PE, steroid

SREAT (Hashimoto's encephalopathy)
- Steroid responsive encephalopathy associated with autoimmune thyroiditis
- Anti-TPO 100%
- SS
  - Subacute encephalopathy
  - seizure
  - myoclonus, ataxia, tremor
  - cognitive impairment
- Rx: rapid response to steroid

Cerebellar ataxia

Acquired
- Mostly acute/subacute
- Any age
- No FHx

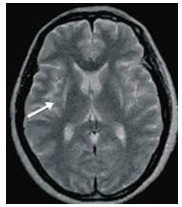
Inherited
- Chronic
- Age<50
- FHx

- Stroke
- Toxic and vitamin def
- CNS infection
- Paraneoplastic cerebellar degeneration (PCD)
- Autoimmune disease
- Superficial siderosis
- Non-hereditary neurodegeneration → **MSA**

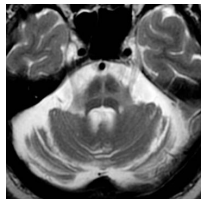
MSA

	Autonomic dysfunction	Parkinsonism	Cerebellar dysfunction
MSA	++++	+	+
MSA-P	++++	++++	+
MSA-C	++++	+	++++
Other features	• Sometimes asymmetry • Predominant AUTONOMIC (Orthostatic hypoT >30/15, ED, urinary incontinence) • Non-motor: stridor, dysphonia, OSA, mood, RBD • Anterocollis / camptocormia • Hyperreflexia and BBK sign • 40% response to L-Dopa		

MSA-P: Putaminal rim sign (T2)



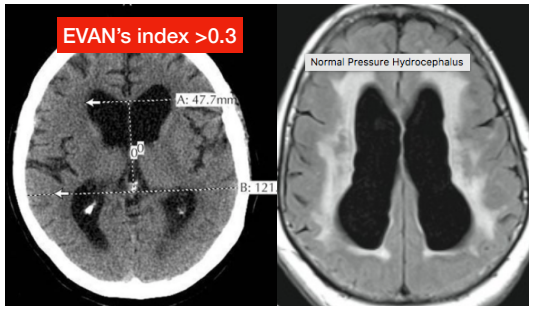
MSA-C: Hot cross bun sign (T2)



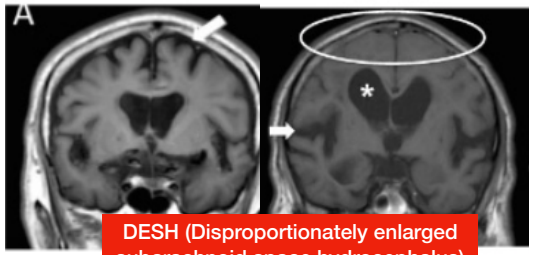
Ataxia

- Acute or chronic
  - Sensory ataxia
  - Cerebellar ataxia
  - Frontal ataxia
    - NPH
    - Vascular dementia, Vascular parkinsonism

NPH



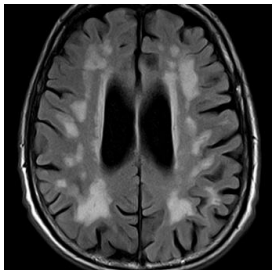
Not NPH NPH

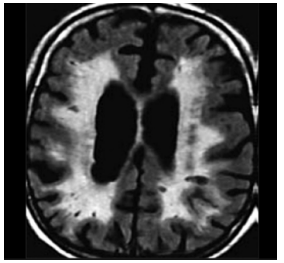


DESH (Disproportionately enlarged subarachnoid space hydrocephalus)

- Insidious >3-6mo, age >40y
- No antecedent event
- Examination
  - Gait: apractic, magnetic, parkinsonian gait, retropulsion
  - Cognition: psychomotor slowing, executive
  - Urinary incontinence
- NOT SEEN: papilledema, seizure, headache
- Dx: LP OP<18, release 50ml

Vascular parkinsonism Vascular dementia





- Stepwise onset, progression, or acute
- Parkinsonism
  - Gait: Lower half parkinsonism, early
- Cognitive: psychomotor retardation
- Urinary incontinence
- Corticospinal or pseudo bulbar signs

Outline

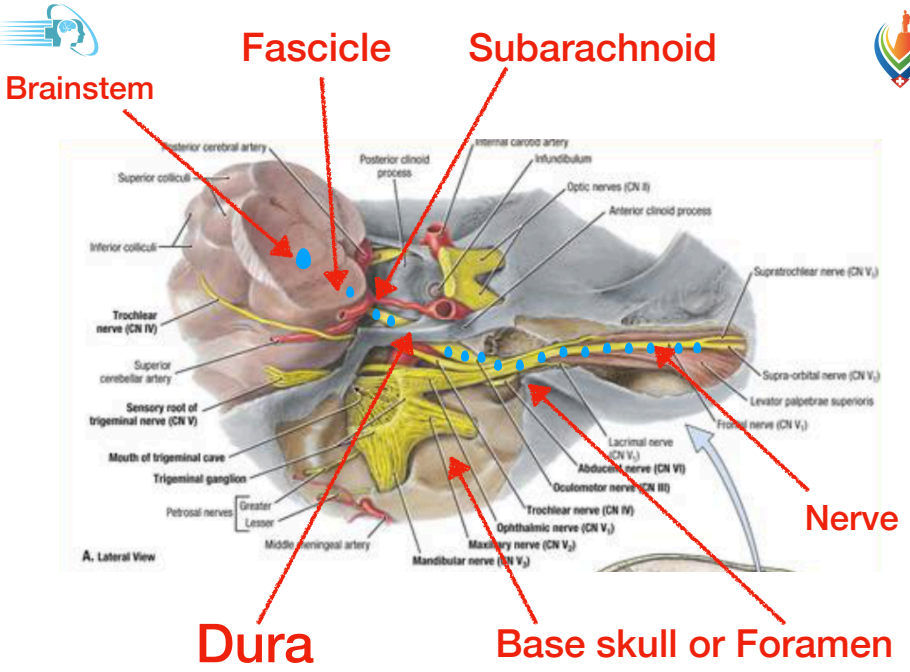
- **Problems**
  - Paraparesis
  - Ataxia
  - **Diplopia**
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Diplopia

- Binocular diplopia
  - Opthalmoparesis (**EOM** abnormality)
- Monocular diplopia
  - Eye disease

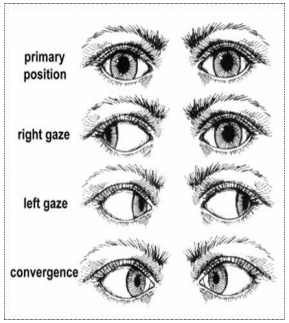
Compatible with CN
- CN III
- CN IV
- CN VI
- Mixed

Not CN palsy
- CNS
  - MB lesion (CN III subnucleus)
  - INO, 1-and-1/2 syndrome
- NMJ: MG, LEM
- Restrictive: thyroid, entrapment, amyloid, infiltrative

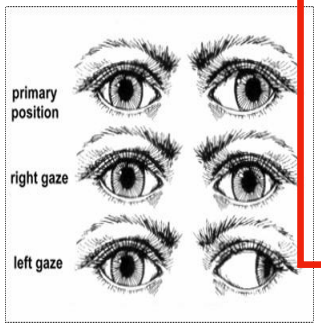


Binocular diplopia

Compatible with CN (CN 3/4/6 or Mixed)



Left INO



Right 1+1/2

NOT Compatible with CN

Not CN palsy
- Supranuclear:
  - Midbrain lesion (CN III subnucleus)
  - INO, 1-and-1/2 syndrome
- NMJ: MG, LEM
- Restrictive: thyroid, entrapment, amyloid, lymphoma

Medial Midbrain-Pon
- stroke
- demy (MS/NMO)

Binocular diplopia

Compatible with CN (CN 3/4/6 or Mixed)

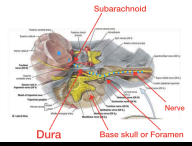
Foramen Syndrome
- Carvernous sinus (3,4,6,5-1,5-2)
- Superior orbital fissure (3,4,6,5-1)
- Orbital apex (2,3,4,6,5-1)
- Internal acoustic meatus (7,8)
- Jugular foramen (9,10,11)
- Hypoglossal canal (12)

Non-foramen
- Subarachnoid
- Dura (pachymeningitis)
- Base of skull
- Nerve

★
- Infection
  - TB
  - Fungus: mucor
- Inflam
  - IgG4
  - Wegener's
  - Tolosa Hunt
- Tumor
  - Lymphoma
  - NPC
- Other infiltrative
  - Amyloid

NOT Compatible with CN

Not CN palsy
- CNS
  - Midbrain stroke (CN III subnucleus)
  - INO, 1-and-1/2 syndrome
- NMJ: MG, LEM
- Restrictive: thyroid, entrapment, amyloid, lymphoma



Non-foramen CN

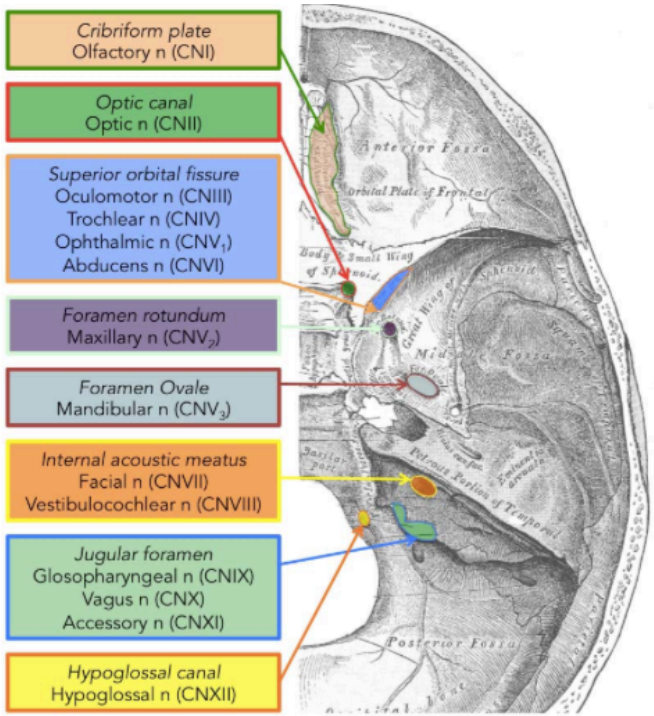
★
- Infection
  - TB
  - Fungus: mucor
- Inflam
  - IgG4
  - Wegener's
  - Tolosa Hunt
- Tumor
  - Lymphoma
  - NPC
- Other infiltrative
  - Amyloid

Subarachnoid
- Meningitis
  - Infection
  - Inflam (drug, SLE, SS, Wegener's
- LM
  - Metastasis (solid, hemato)
  - Behcet's

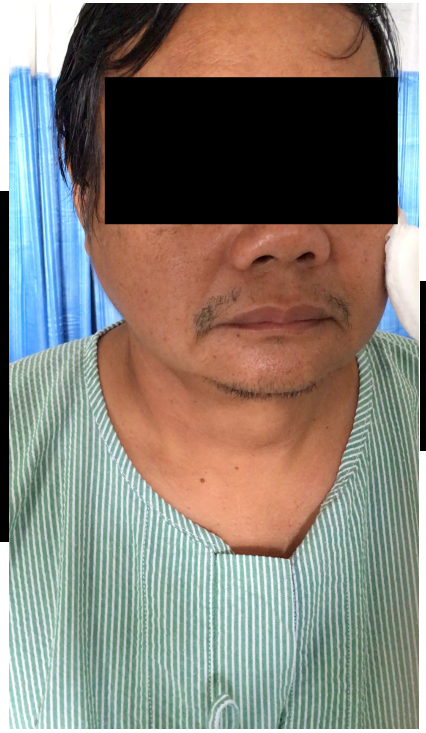
Dura (pachymeningitis)
- Infection: TB, fungus
- Inflam: IgG4, SLE, Wegener's
- Infiltrative: metastasis (solid, hemato)
- Idiopathic

Base of skull
- Infection
  - TB
  - fungus
- Tumor
  - NPC
  - Lymphoma

Nerve
- Infection: crypto
- Infiltrative: Amyloid, metastasis
- Inflammation: MFS
- Vascular: ischemic neuropathy (diabetic CN3 palsy, CN6)



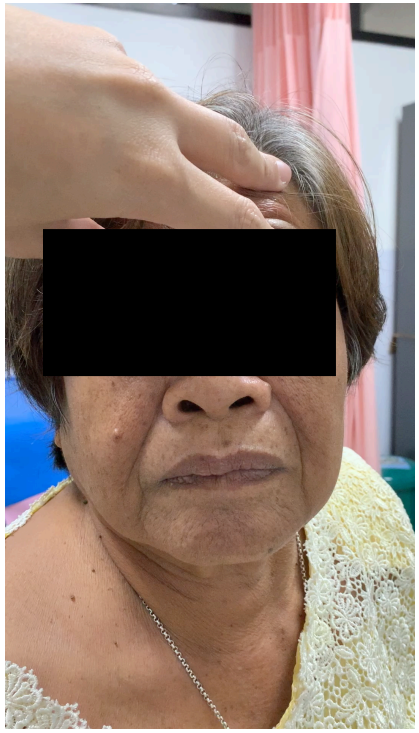
CN3 palsy
- BS lesion
- Subarachnoid : PCOM aneurysm
- Nerve
  - Cavernous
  - SOF
  - Other



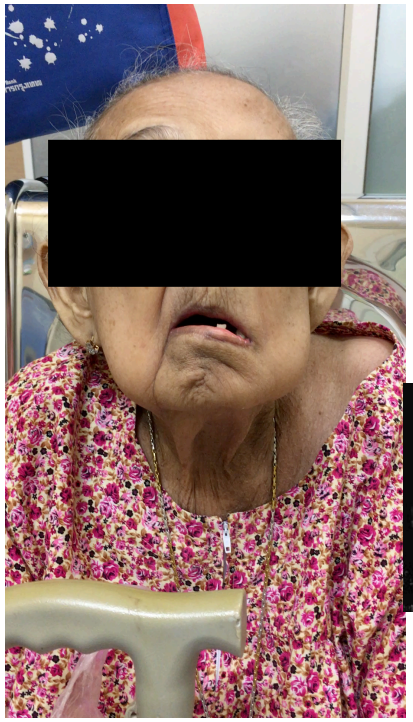
Pupil sparing
MRI: normal,
HbA1C 15.6
Dx Ischemic CN3

Isolated CN
- Nucleus: rare
- Fascicle
- Nerve
  - Subarachnoid
  - Dura
  - Base skull
  - after foramen

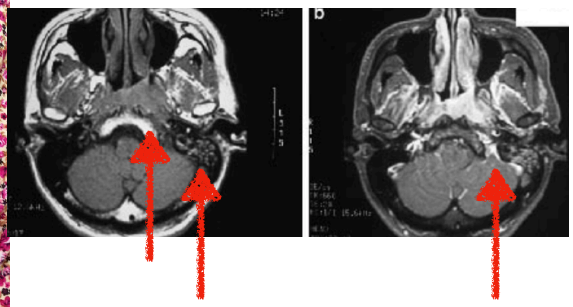
ดู Rt Intorsion
(Rt CN3 palsy)

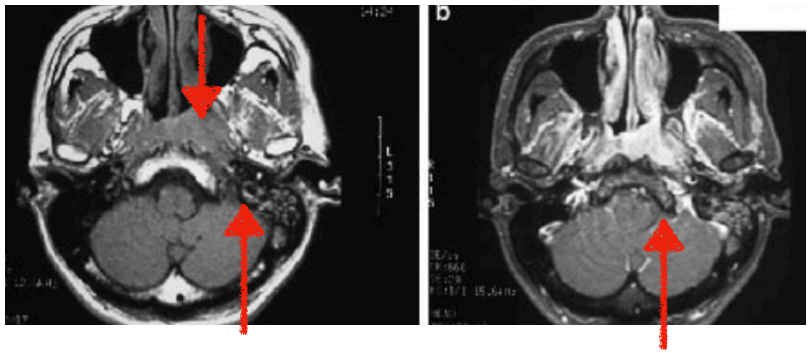


ถ้า CN3 palsy จะตรวจ CN4 โดยการให้มองlateral แล้วมองลง แล้วดู intorsion



F80 Left FP-LMN + Left HL 3 mo
- Localization IAC
- MRI NPC involve IAC
- Dx Metastatic NPC

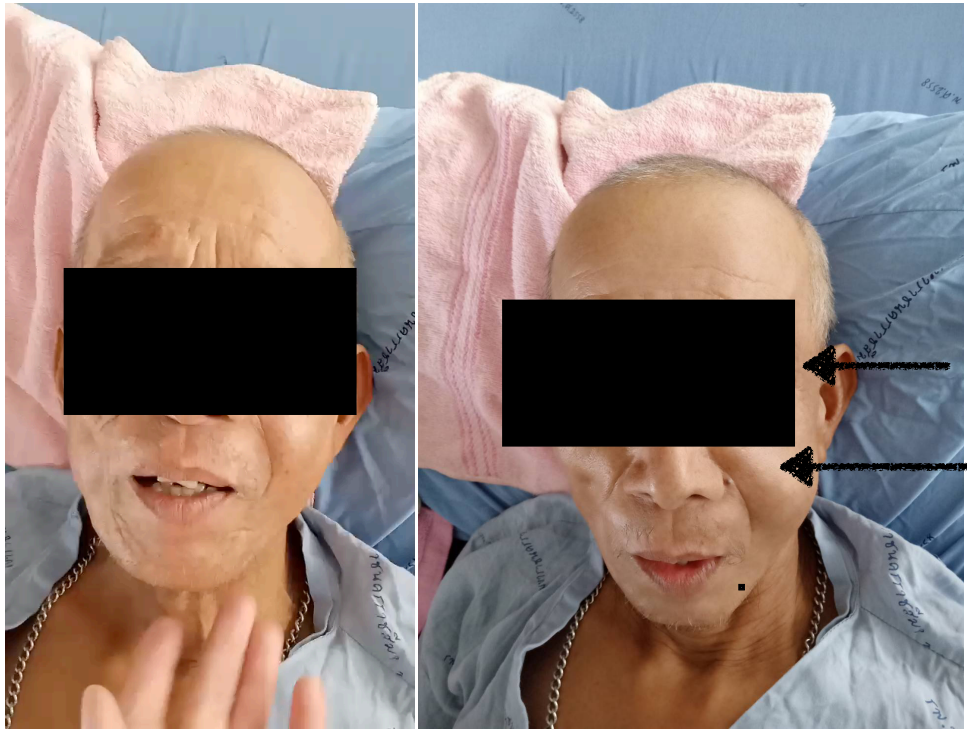


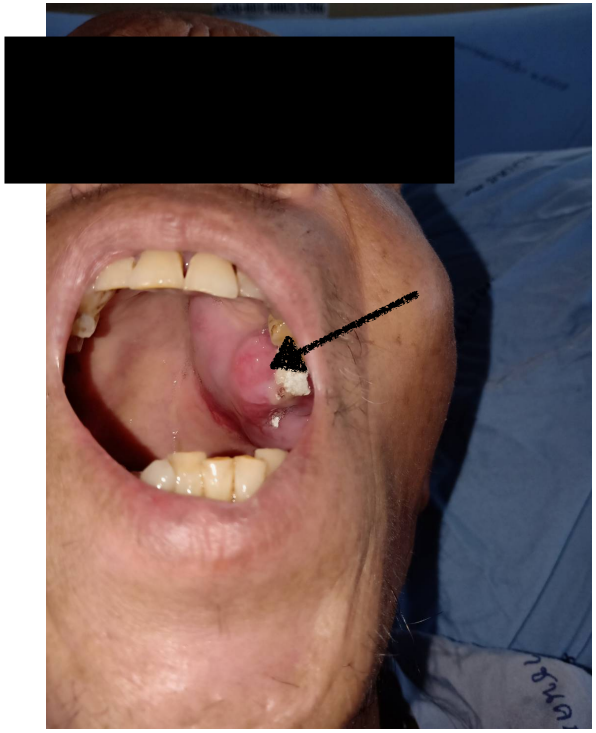


Vestibular schwannoma	54
Middle ear and mastoid inflammation	
No history of NPC*	34
History of NPC	4
Newly diagnosed NPC	1
Ischaemic foci in brainstem	16
Cavernous haemangioma in pons	1
Other cerebellopontine angle masses	
Meningioma	3
Trigeminal neuroma	3
Arachnoid cyst	2
Epidermoid cyst	1
Ninth-to-11th nerve schwannoma complex	1
Inner ear dysplasia	4
Vascular loop with compression	7
Chronic cryptococcal meningitis	1

Hearling loss - IAC
1. Vestibular schwannoma 54%
2. NPC 39%
3. Other CPA mass

Hong Kong Med J 2004;10:38-4





NK lymphoma with restrictive ophthalmoparesis

Binocular diplopia

- Compatible with CN (CN 3/4/6 or Mixed)
  - Foramen Syndrome
    - Carvernous sinus (3,4,6,5-1,5-2)
    - Superior orbital fissure (3,4,6,5-1)
    - Orbital apex (2,3,4,6,5-1)
    - Internal acoustic meatus (7,8)
    - Jugular foramen (9,10,11)
    - Hypoglossal canal (12)
  - Non-foramen
    - Dura (pachymeningitis)
    - Subarachnoid
    - Base of skull
    - Nerve
      - Infection
        - TB
        - Fungus: mucor
      - Inflam
        - IgG4
        - Wegener's
        - Tolosa Hunt
      - Tumor
        - Lymphoma
        - NPC
      - Other infiltrative
        - Amyloid
- NOT Compatible with CN
  - Not CN palsy
    - CNS
      - Midbrain lesion (CN III subnucleus)
      - INO, 1-and-1/2 syndrome
    - NMJ: MG, LEM
    - Restrictive: thyroid, entrapment, amyloid, lymphoma

Outline

- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - **Multiple Cranial Neuropathy**
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Multiple cranial neuropathy

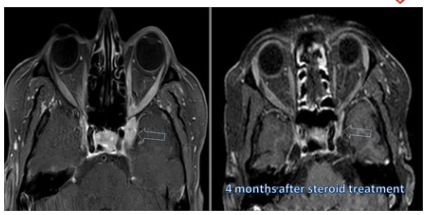
- Subarachnoid space
- Base of skull
- Foramen syndrome

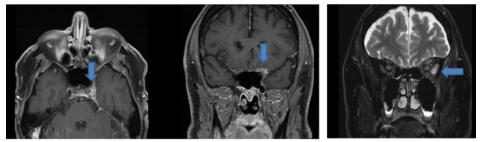
SAME DIAGNOSTIC APPROACH

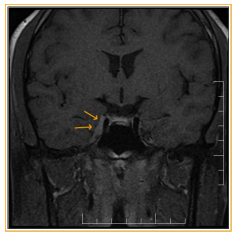
- Infection
  - TB
  - Fungus: mucor
- Inflam
  - IgG4
  - Wegener's
  - Tolosa Hunt
- Tumor
  - Lymphoma
  - NPC
- Other infiltrative
  - Amyloid

Tolosa Hunt Syndrome

- **Idiopathic inflammation of cavernous sinus, superior orbital fissure and/or orbital apex (orbital pseudotumor)**
- SS:
  - **Unilateral headache with orbital pain**
  - Ophthalmoplegia (**CN 3,4,6 palsy**) and ptosis
  - Other: fever, fatigue, vertigo, exophthalmos
- Dx: SPEP, **LP**, **MRI** to exclude other causes, sometimes need biopsy (if not response to Rx)
- **MRI: enhanced and T2 hyperSI in CS, SOF and/or orbital apex**
- Treatment: **Steroid** and steroid sparing agents (eg. MTX/AZA), RT
- Good prognosis, good response to steroid







Outline

- **Problems**
  - Paraparesis
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  - **Peripheral Neuropathy**
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- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Peripheral Neuropathy

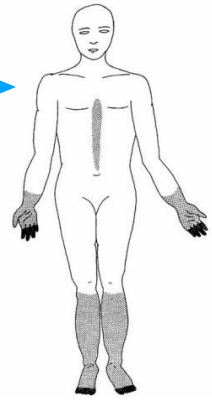
- Mononeuropathy -> short case or OSCE
- Polyneuropathy
- Mononeuropathy multiplex or multiple mononeuropathy

Polyneuropathy

- Demyelinating vs Axonopathy
- Acute, subacute or chronic
- Symmetry vs asymmetry
- Predominantly fiber type: motor, sensory, autonomic
- CN involvement
- Nerve hypertrophy

Demyelinating vs Axonopathy

- **Axonopathy**
  - Length dependent
  - Weakness with wasting
  - Glove and stocking
- **Demyelination**
  - Predominant upper limb onset
  - Proximal involvement
  - Weakness without wasting
  - Impaired proprioception (Ataxia)



NCV and EMG may be helpful to differential

Polyneuropathy

- Demyelinating vs Axonopathy
- Acute, subacute or chronic
- Symmetry vs asymmetry
- Predominantly fiber type: motor, sensory, autonomic
- CN involvement
- Nerve hypertrophy

- Acute (<4wk)
  - GBS, Vasculitis, porphyria
  - Toxic
- Subacute (4-8wk)
- Chronic (>8wk)
  - CIDP
  - CMT
  - almost all axonal neuropathy

Polyneuropathy

- Demyelinating vs Axonopathy
- Acute, subacute or chronic
- Symmetry vs asymmetry
- Predominantly fiber type: motor, sensory, autonomic
- CN involvement
- Nerve hypertrophy

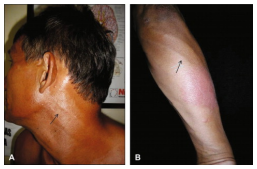
- Mononeuropathy multiplex
- or multiple mononeuropathy

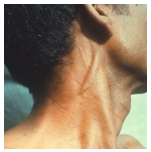
Polyneuropathy

- Demyelinating vs Axonopathy
- Acute, subacute or chronic
- Symmetry vs asymmetry
- Predominantly fiber type: motor, sensory, autonomic
- CN involvement
- Nerve hypertrophy

Pain
- DM
- Vasculitis
- Infiltrative (lymphoma)
- Amyloidosis
- Small fiber

- Chronic neuropathy
  - CIDP
  - CMT
- Infiltrative
  - Amyloid
  - Lymphoma
  - Leprosy

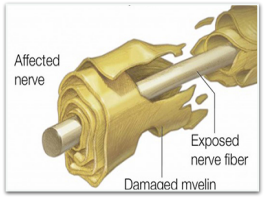




Polyneuropathy

- **Acute: GBS**, vasculitis
- Chronic
  - Axonal neuropathy
  - Demyelinating neuropathy

GBS



- S&S
  - rapidly progressive **bilateral** weakness
  - **symmetrical**, **distal and/or proximal**
  - **CN** involvement (esp. bilat facial weakness), autonomic, pain
  - DTR 0
  - **respiratory** muscle (25%)
  - mild sensory symptom
  - **maximum in 4 wk (mostly 2wk)**
- Ix: may be **normal in 1st week after onset**
  - **CSF: albuminocytologic dissociation**
    - **If +ve WBC: carcinomatosis, HIV**
  - NCV: demyelination pattern (decrease CV)

Table I Guillain-Barré syndrome disability scale

0. Healthy
1. Minor symptoms or signs of neuropathy but capable of manual work/*capable of running*
2. Able to walk without support of a stick (*5 m across an open space*) but incapable of manual work/*running*
3. Able to walk with a stick, appliance or support (*5 m across an open space*)
4. Confined to bed or chair bound
5. Requiring assisted ventilation (*for any part of the day or night*)
6. Death

The original scale is shown in regular print (Hughes *et al.*, 1978) and subsequent modifications in *italics* (Plasma Exchange/Sandoglobulin Guillain-Barré Syndrome Trial Group, 1997).

- Post infectious immune process, monophasic disease
  - 2/3: positive Hx URI (40%), diarrhea (27%)
  - post vaccination, post surgical, stress event
- Pathogen
  - CMV, EBV, *M. pneumoniae*, *H. influinzae*, *HIV*
  - *Campylobactor jejuni*

GBS Treatment

Unable to walk unaided (Guillain-Barré syndrome disability score ≥3), especially when less than 2 weeks from onset of weakness?
- Treatment indication with IVIg (0·4 g/kg daily for 5 days) or plasma exchange
- Mildly affected patients (Guillain-Barré syndrome disability score 1–2): check for further deterioration or treatment indication

TRF after IVIg or plasma exchange?
- Deterioration after initial stabilisation or improvement: re-treatment with IVIg (0·4 g/kg daily for 5 days) or plasma exchange

GBS Variants

GBS Variants
- **Miller-Fisher variant: anti-GQ1b**
  - **ataxia, areflexia, opthalmoplegia (cranial nerve)**
- **AMAN**: anti-GD1a
  - acute motor axonal neuropathy
- **AMSAN**: anti-GD1a
  - acute motor-sensory axonal neuropathy
- Pure dysautonomia

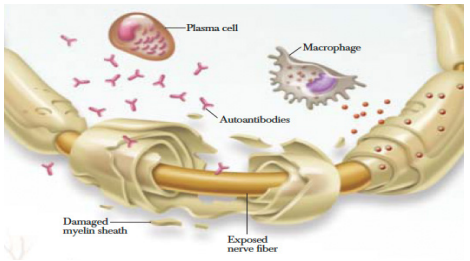
Polyneuropathy

- Acute: GBS, vasculitis
- Chronic
  - Axonal neuropathy
    - Toxic/Drugs: Alcohol, CMT (Vincristine, platinum), PHT, metronidazole, dapsone, B12def
    - Infection: HIV
    - CTD: SS, SLE, RA
    - Metabolic: DM, thyroid, liver, renal
    - Paraprotein: MM, WM, MGUS
    - Paraneoplastic: CA lung/ovary
    - Inherited: Familial amyloid neuropathy
  - Demyelinating neuropathy
    - Acquired
      - CIDP
      - POEM
    - Genetic
      - CMT
      - HNPP

CIDP

- Progress >2mo, motor > sensory
- Symmetrical, arms and legs
- Proximal and distal
- Absent DTR
- CSF: albuminocytologic dissociation
- EDx: Demy

- CIDP associated systemic dz
  - Infection
    - HIV, HBV, HCV
  - Monoclonal gammopathy
    - MGUS, MM
    - WM, cryoglobulin
    - POEM
  - DM

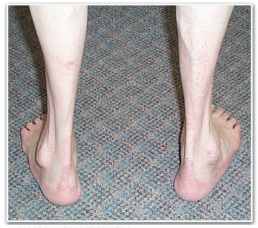


Rx
- Workup 2nd cause and Rx
- Steroid
- IVIG
- PLEX

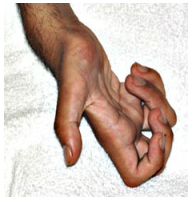
N Engl J Med 2005;352:1343-56.

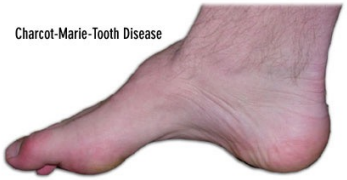
CMT

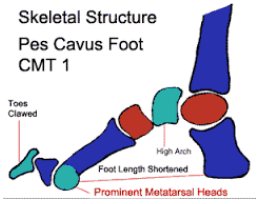
- Hereditary sensory motor neuropathy (HMSN1)
- Chronic demyelination
- Motor and sensory
- Distal leg weakness
- Foot deformities
  - Pes Cavus
  - hammer toes
  - Stork leg deformity

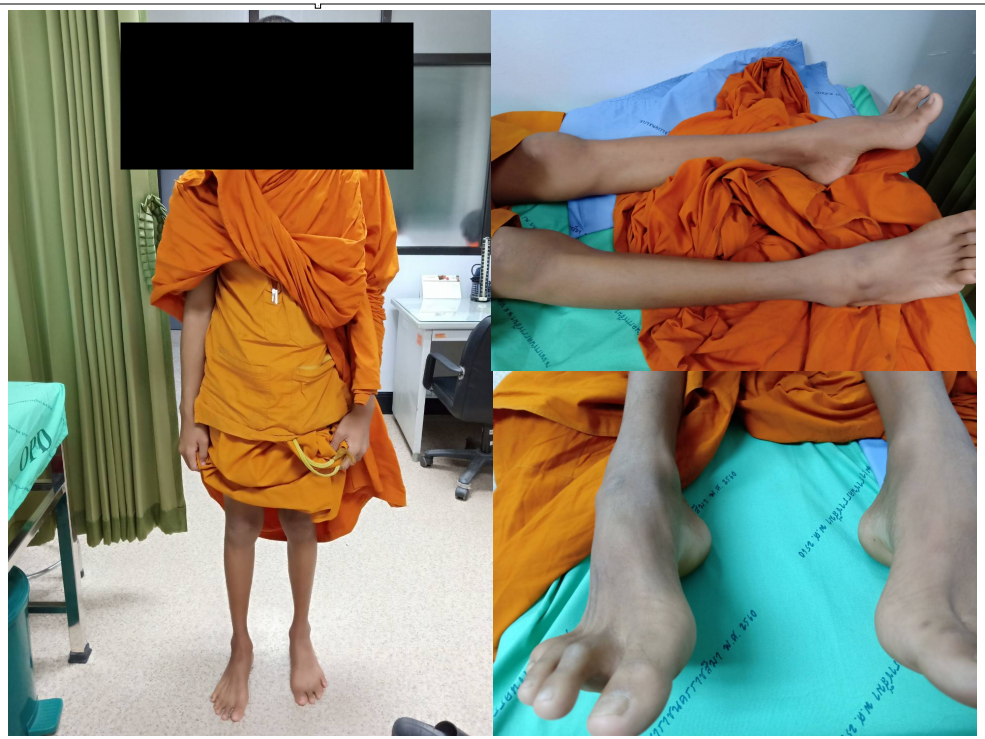


Hammer Toe









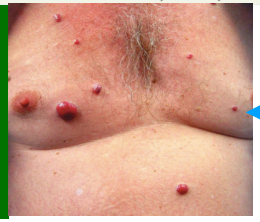
POEMS

- POEMS
  - Polyneuropathy (Demy) 100%
  - Organomegaly 45-85%
  - Endocrinopathy 67-84%
  - Monoclonal protein 100%
  - Skin change 68-89%
- Other
  - sclerotic bone 60-96%
  - Papilledema 29-64%
  - Extravascular edema 30-90%
  - Polycythemia/thrombocytosis
  - Ascites
  - Castleman

Table 1 Criteria for the Diagnosis of POEMS Syndrome[a]

Mandatory Major Criteria	1. Polyneuropathy (typically demyelinating)
	2. Monoclonal plasma cell proliferative disorder (almost always λ)
Other Major Criteria (one required)	3. Castleman disease[a]
	4. Sclerotic bone lesions
	5. Vascular endothelial growth factor elevation
Minor Criteria (one required)	6. Organomegaly (splenomegaly, hepatomegaly, or lymphadenopathy)
	7. Extravascular volume overload (edema, pleural effusion, or ascites)
	8. Endocrinopathy (adrenal, thyroid[b], pituitary, gonadal, parathyroid, pancreatic[b])
	9. Skin changes (hyperpigmentation, hypertrichosis, glomeruloid hemangiomata, plethora, acrocyanosis, flushing, white nails)
	10. Papilledema
	11. Thrombocytosis/polycythemia[c]
Other Symptoms and Signs	Digital clubbing, weight loss, hyperhidrosis, pulmonary hypertension/restrictive lung disease, thrombotic diatheses, diarrhea, low vitamin B12 values

- Dx
  - CIDP mimic
  - High VEGF
  - SPEP - monoclonal
- Rx
  - RT >50%
  - Steroid >15%
  - Standard alkylator based therapy >90%
  - High dose CMT with PBSCT >90%



Glomeruloid Hemangioma

Polyneuropathy

- Demyelinating vs Axonopathy
- Acute, subacute or chronic
- Symmetry vs asymmetry
- Predominantly fiber type: motor, sensory, autonomic
- CN involvement
- Nerve hypertrophy

Chronic Axonopathy

Bilat symmetrical distal weakness and sensory loss

- Metabolic: DM, thyroid, RF
- Drug and toxin, Vitamin def
- Monoclonalgammopathy
- Infection: HIV
- Paraneoplastic
- Genetic: CMT, amyloidosis

Pure Motor

Bilat symmetrical distal weakness without sensory loss

- Porphyria
- Lead
- GBS
- CMT
- Diptheria, Dapsone

Bilat proprioceptive loss without weakness

- Paraneoplastic
- Sjogren
- Drug: cisplatinum
- HIV

Sensory Ataxia

Prominent autonomic

- DM
- Amyloidosis
- Porphyria
- HIV
- Vincristine
- GBS

Small fiber

- DM, IFG
- Amyloid
- HIV
- SS
- HMSN1
- Fabry's
- Tangier
- Idiopathic

Ix: QST

Mononeuropathy multiplex or multiple mononeuropathy

- Ddx
  - Vasculitic neuropathy
    - Primary vasculitis
    - Secondary vasculitis
    - Nonsystemic vasculitis
  - Immune
    - MMN (multifocal motor neuropathy)
  - Genetic
    - HNPP

Vasculitic neuropathy

- **PRIMARY**
  - Small vessel vasculitis
    - ANCA
      - MPA
      - EGPA (Churg-Strauss syndrome)
      - GPA (Wegener granulomatosis)
    - Immune
      - Essential mixed cryoglobulinemia (Non-HCV)
  - Medium vessel vasculitis
    - PAN
- **SECONDARY**
  - CTD
    - RA
    - SLE
    - Sjogren
    - MCTD
  - Infection
    - HIV, HCV, HBV, CMV
    - Leprosy
  - Malignancy
    - Lymphoma

Investigation in Neuropathy

- NCS
- CSF: GBS, CIDP, radiculoneuropathy e.g. CMV, metastasis
- SPEP, Immunofixation
- TSH, B12
- Nerve biopsy
  - Vasculitic neuropathy
  - Infiltrative: lymphoma, amyloidosis, sarcoidosis
  - Infection: leprosy

Outline

- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - **Proximal weakness**
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Proximal weakness

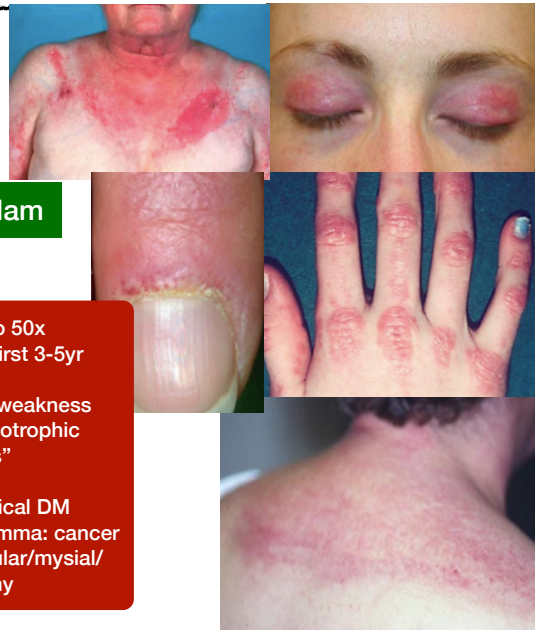
- **Myopathy**
- **NMJ disease**
  - MG
  - LEM
- Polyneuropathy (demyelinating disease eg. AIDP, CIDP)

Muscle disease

- **Acquired**
  - **Inflam**
    - Primary
      - DM
      - PM
      - NAM
      - IBM
    - Secondary
      - Infection
  - **Non-inflam**
    - Endocrine
      - Thyroid: hypo/hyper
      - Adrenal: Cushing/AI
    - HypoK
    - HypoMg/Ca
    - Toxic/Drug
    - Critical illness
- **Hereditary**
  - Congenital
  - Muscular dystrophy
  - Myotonic dystrophy
  - Channalopathy
  - Metabolic myopathy
  - Mitochondrial myopathy

Muscle disease

- **Acquired**
  - **Inflam**
    - Primary
      - DM
      - PM
      - NAM
      - IBM
    - Secondary
      - Infection
  - **Non-inflam**



- Woman, CK upto 50x
- Cancer 9-32%, first 3-5yr
- Subacute
- Skin + proximal weakness
- If only skin “amyotrophic dermatomyositis”
- Ab
  - Anti-Mi2: typical DM
  - Anti-TIF1-gamma: cancer
- Patho: perivascular/mysial/ fascicular atrophy

Muscle disease

- **Acquired**
  - **Inflam**
    - Primary
      - DM
      - PM
      - NAM
      - IBM
    - Secondary
      - Infection
  - **Non-inflam**
- **Hereditary**

- Acute or subacute severe weakness, bulbar weakness, respiratory muscle
- CK >50x
- +- Statin exposure
- Anti-SRP, Anti-HMGCR
- Patho: scattered necrotic fibers

Treatment of immune myopathy (DM, PM and NAM)

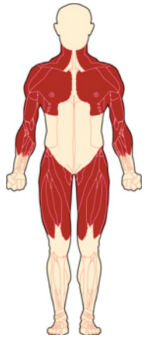
- Initial Rx
  - Pred 1 MKD for 4-6wk
  - If severe: IVMP 1g for 3-5d
- Steroid sparing if response
  - Azathioprine, MTX, MMF, CSA
- Steroid non-responsive
  - IVIG
- Refractory
  - RTX

Muscle disease

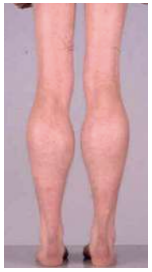
- **Acquired**
  - **Inflam**
    - Primary
      - DM
      - PM
      - NAM
      - IBM
    - Secondary
      - Infection
  - **Non-inflam**
    - Endocrine
      - Thyroid: hypo/hyper
      - Adrenal: Cushing/AI
    - HypoK
    - HypoMg/Ca
    - Toxic/Drug
    - Critical illness
- **Hereditary**
  - RENAL K LOSS
    - Suspected Aldo-related
      - 1ry aldosteronism (Conn)
        - PAC>15,PRA<1 and PAC/PRA >20
        - Saline loading test 2L NSS in 4h, PAC>10
        - Adrenal CT
      - 2nd aldosteronism
        - RAS
        - Renin-secreting tumor
    - RTA
  - K-SHIFT
    - HypoK-PP, Thyrotoxic-PP

Muscle disease



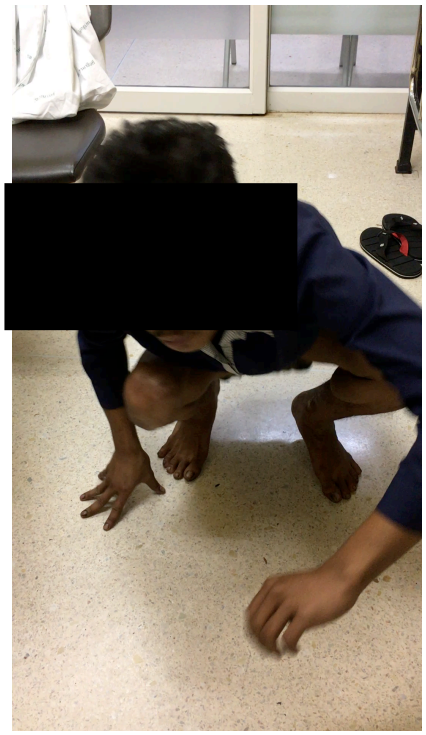


- Acquired
- Hereditary

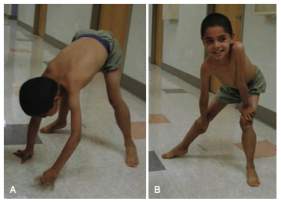

Toe walking


BMD (Becker)
- Male, XR, abnormal dystrophin
- onset 5y, ambulate >15y, death 40-50y
- SS
  - Calf pseudohypertrophy
  - Archillis contracture
  - Cardiomyopathy
- CK 5000-20000
- Bx: decrease dystrophin

- Congenital
- **Muscular dystrophy**
- Myotonic dystrophy
- Channalopathy
- Metabolic myopathy
- Mitochondrial myopathy

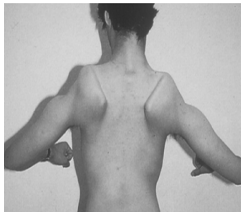
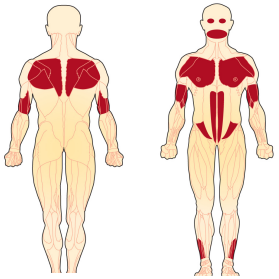


BMD Dx by muscle Bx



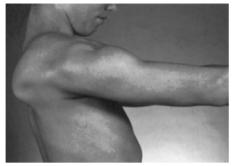
Muscle disease

- Acquired
- Hereditary

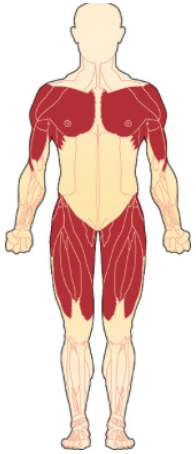
FSHD
- AD, onset 6-20y, extremely slow progress, normal lifespan
- SS
  - Asymmetry
  - Face (O.oculi, oris, zygomaticus) inability to purse lip, close eye, whistle
    - Spare EOM and mastication
  - Arm & shoulder (Popeye = relative spare forarm)
- Ix: genetic test
- Rx supportive

- Congenital
- **Muscular dystrophy**
- Myotonic dystrophy
- Channalopathy
- Metabolic myopathy
- Mitochondrial myopathy



Muscle disease

- Acquired
- Hereditary



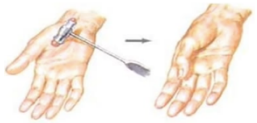
LGMD
- AD or AR
- onset 10-30y
- Slow progress, normal lifespan & IQ
- Spare facial m.
- No calf hypertrophy

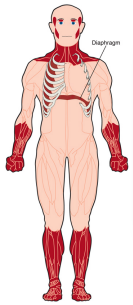
- Congenital
- **Muscular dystrophy**
- Myotonic dystrophy
- Channalopathy
- Metabolic myopathy
- Mitochondrial myopathy

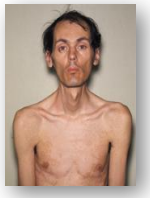
Muscle disease

Acquired

Percussion myotonia

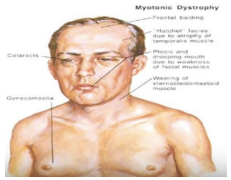


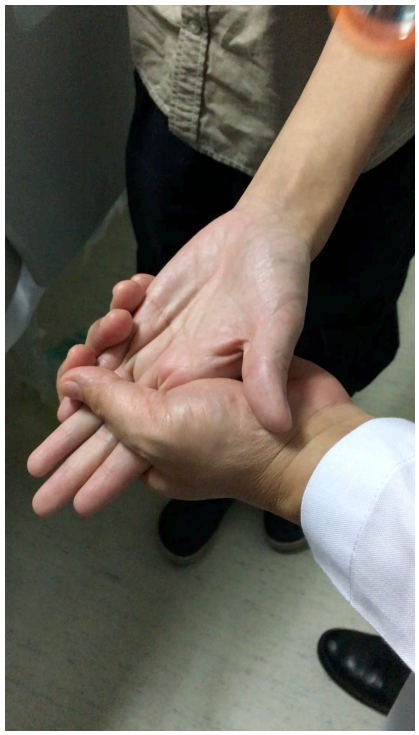




Myotonic dystrophy
- AD, CTG repeat, onset 30-40y (DM1)
- SS
  - Distal weakness with impair relaxation (Myotonia)
  - Extramuscular: CHB, infertility, DM, cataract
- PE: baldness, hatched face, ptosis, percussion myotonia, gynecomastia and testicular atrophy
- Ix: EMG - myotonic discharge

Hereditary
- Congenital
- Muscular dystrophy
- Myotonic dystrophy
- Channalopathy
- Metabolic myopathy
- Mitochondrial myopathy



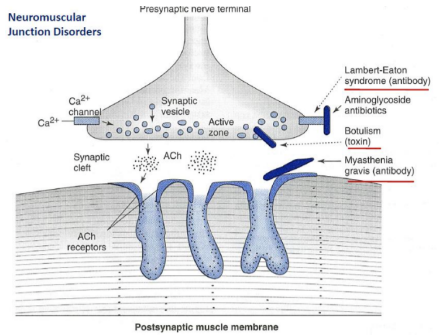


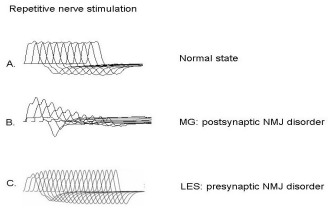
Proximal weakness

- Myopathy
- NMJ disease
  - MG
  - LEM
- Polyneuropathy (demyelinating disease eg. AIDP, CIDP)

MG

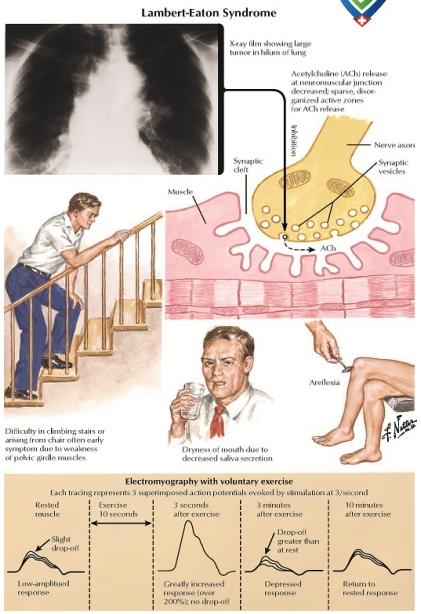
- **Ach receptor Ab** at post synaptic
- **PE: ptosis, optjhthamoparesis, fluctuation, prox weakness, neck flexor, dysphagia**
  - **sustained up gaze 1-2min, Enhanced ptosis, Cogan lid twitching**
- Dx:
  - Icepack test
  - Tensilon test: edrophonium or Neostigmine test
  - EDx:
    - RNS decremental/ fatigability
    - Single-fiber EMG - high ss, low sp
  - AntiAchR, AntiMuSK
- **OMG**
  - 50-60 % develop generalized in 2 years (80 % within 1 year)
  - 40 % remain ocular
  - rarely to develop generalized MG if pure ocular > 2 years





LEMs

- Cause
  - **Anti-VGCC 80% = SCLC**
  - Autoimmune 20%
- **Triad**
  - Prox weakness > distal
  - Autonomic dysfunction ปากแห้ง คอแห้ง ED
  - **Areflexia (Enhanced reflex +ve)**
  - Ocular (ptosis, diplopia), Bulbar (dysphagia, dysarthria, facial weakness)
- Ix : **CT-CHEST**
  - RNS, slow frequency: decremental as MG
  - RNS, fast frequency: incremental ตรงข้ามกับ MG
- Rx:
  - Cancer
  - Di-aminopyridine (3,4 DAP)
  - steriod, IVIG, PEx



Proximal weakness

- Myopathy
- NMJ disease
  - MG
  - LEM
- **Polyneuropathy (demyelinating disease eg. AIDP, CIDP)**

Outline

- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
- **Seizure**
- Parkinsonism
- Stroke
- Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

First Seizure

Provoked seizure
(Acute Symptomatic Seizure)

Extracranial

- Metabolic
  - Hypoglycemia/ Hyperglycemia
  - Hypo/Hypernatremia
  - Hypocalcemia
  - Hypomagnesemia
- Drugs/Toxic
  - Amphetamine, Cannabinoid
  - Alcohol withdrawal

Intracranial

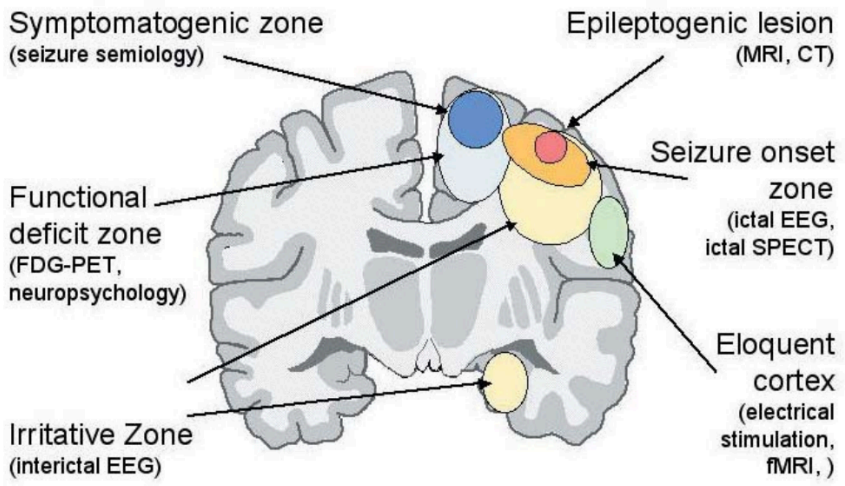
- Non mass
  - Infection
    - Meningitis
    - Encephalitis
  - SAH
- Mass
  - Infection
    - abscess
    - cerebritis
  - Tumor: 1ry or 2ry
  - Vascular
    - Ischemic stroke
    - ICH (HT vs. lobar)
    - CVST
    - Vascular malformation (AVM/ AVF)
  - TBI

Unprovoked seizure
(Reflex seizure)

Epilepsy ?

- **Epilepsy: definition?**
  - **1. At least 2 unprovoked (or reflex) seizures occurring >24 hr apart**
    - After 2 unprovoked = risk 73% at 4 yrs
    - After 1 unprovoked = risk 40-52%
  - **2. One unprovoked (or reflex) seizure and a probability of further seizures similar to the general recurrent risk (>60% over 10 years)**
    - Eg. Stroke, infection, TBI
  - **3. Epilepsy syndrome**

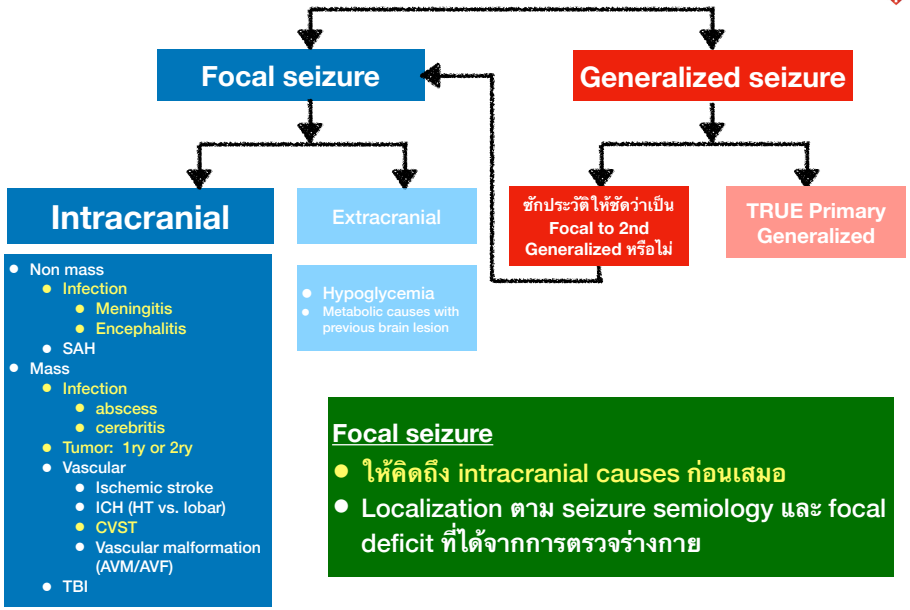
Epileptogenic zone in seizure



Seizure Semiology

Clinical feature	Anatomical origin	Lateralization
Well-defined somatosensory symptoms	parietal (primary sensory cortex)	contralateral
Unilateral elementary visual phenomena	occipital	contralateral
Ascending visceral feelings	mesiotemporal, insula, supplementary motor area	none
Forced thinking	frontal or mesiotemporal	dominant hemisphere
Ictal fear	amygdala, hippocampus	none
Forced head version	frontal, temporal	contralateral
Nonversive head turning	temporal	ispilateral
Focal clonic activity	frontal (primary motor cortex)	contralateral
Unilateral dystonia	temporal or frontal (basal ganglia)	contralateral
Nystagmus	frontal eye field or parieto-temporal junction	contralateral to fast component
Ictal laughing	hypothalamus, temporal, mesiofrontal	none
Ictal eye closure	nonepileptic seizure	none
Asymmetric termination of cloni	temporal, frontal	ipsilateral (to the last cloni)
Postictal paresis	frontal, temporal	contralateral
Postictal nose wiping	temporal, frontal	ipsilateral
Postictal aphasia/dysnomia	frontal, temporal, parietal	dominant hemisphere

Seizure

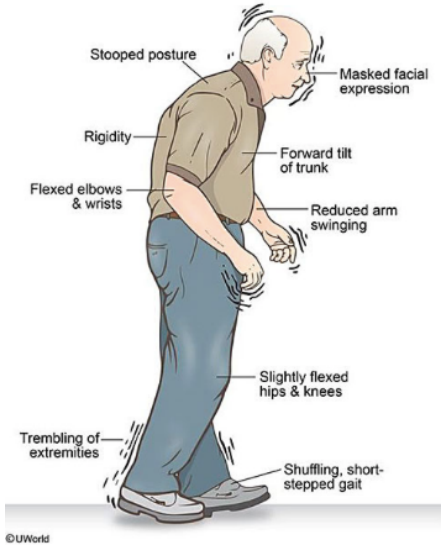


Outline

- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - **Parkinsonism**
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Parkinsonism

- **At least 2 in 4**
  - **Rest tremor**
  - **Bradykinesia**
  - **Rigidity**
  - **Postural instability**
- Parkinson's disease
  - Bradykinesia plus 1 in 3



PD vs ET

	Parkinsonian tremor	Essential tremor
Pattern of tremor	**Resting**	Action
Family history	< 5%	**> 60%**
Frequency of tremor	**3-6 Hz**	5-12Hz
At initial phase	**Unilateral**	**Bilateral, some asymmetry**
Area involvement	**Hand, leg, chin** and mouth	**Hand, head and voice**
Writing characteristic	**Small** alphabet	**Large** alphabet
Alcohol responsive	No	Yes
Clinical course	Add on other symptoms of parkinsonism	Tremor is a major symptom
Treatment	Dopaminergic agents	Propranolol, Primidone, Topiramate, Gabapentin

Parkinsonian gait: Stoop posture, rest tremor, short step

Parkinson's Disease

- **Bradykinesia + Rest tremor/ Postural instability/ Rigidity**
- **Unilateral** onset and persistent asymmetry
- **Resting tremor** present
- **Progressive** disorder and clinical course **> 10 yr**
- **Excellent response to Levodopa** and response **> 5 yr**
- **Levodopa induce dyskinesia**

Absolute exclusion criteria: The presence of any of these features rules out PD:	
☐ 1. Unequivocal cerebellar abnormalities, such as cerebellar gait, limb ataxia, or cerebellar oculomotor abnormalities (eg, sustained gaze evoked nystagmus, macro square wave jerks, hypermetric saccades)	MSA-c
☐ 2. Downward vertical supranuclear gaze palsy, or selective slowing of downward vertical saccades	PSP
☐ 3. Diagnosis of probable behavioral variant frontotemporal dementia or primary progressive aphasia, defined according to consensus criteria [2] within the first five years of disease	FTD
☐ 4. Parkinsonian features restricted to the lower limbs for more than three years	NPH/VaD
☐ 5. Treatment with a dopamine receptor blocker or a dopamine-depleting agent in a dose and time-course consistent with drug-induced parkinsonism	Drug
☐ 6. Absence of observable response to high-dose levodopa despite at least moderate severity of disease	
☐ 7. Unequivocal cortical sensory loss (ie, graphesthesia, stereognosis with intact primary sensory modalities), clear limb ideomotor apraxia, or progressive aphasia	CBD
☐ 8. Normal functional neuroimaging of the presynaptic dopaminergic system	
☐ 9. Documentation of an alternative condition known to produce parkinsonism and plausibly connected to the patient's symptoms, or, the expert evaluating physician, based on the full diagnostic assessment feels that an alternative syndrome is more likely than PD	

MSA

Red flags
☐ 1. Rapid progression of gait impairment requiring regular use of wheelchair within five years of onset
☐ 2. A complete absence of progression of motor symptoms or signs over five or more years unless stability is related to treatment
☐ 3. Early bulbar dysfunction: severe dysphonia or dysarthria (speech unintelligible most of the time) or severe dysphagia (requiring soft food, NG tube, or gastrostomy feeding) within first five years
☐ 4. Inspiratory respiratory dysfunction: either diurnal or nocturnal inspiratory stridor or frequent inspiratory sighs
☐ 5. Severe autonomic failure in the first five years of disease. This can include: a. Orthostatic hypotension [3]-orthostatic decrease of blood pressure within three minutes of standing by at least 30 mmHg systolic or 15 mmHg diastolic, in the absence of dehydration, medication, or other diseases that could plausibly explain autonomic dysfunction, or b. Severe urinary retention or urinary incontinence in the first five years of disease (excluding long-standing or small amount stress incontinence in women), that is not simply functional incontinence. In men, urinary retention must not be attributable to prostate disease, and must be associated with erectile dysfunction
☐ 6. Recurrent (>1/year) falls because of impaired balance within three years of onset
☐ 7. Disproportionate anterocollis (dystonic) or contractures of hand or feet within the first 10 years
☐ 8. Absence of any of the common nonmotor features of disease despite five years disease duration. These include sleep dysfunction (sleep-maintenance insomnia, excessive daytime somnolence, symptoms of REM sleep behavior disorder), autonomic dysfunction (constipation, daytime urinary urgency, symptomatic orthostasis), hyposmia, or psychiatric dysfunction (depression, anxiety, or hallucinations)
☐ 9. Otherwise-unexplained pyramidal tract signs, defined as pyramidal weakness or clear pathologic hyperreflexia (excluding mild reflex asymmetry and isolated extensor plantar response)
☐ 10. Bilateral symmetric parkinsonism. The patient or caregiver reports bilateral symptom onset with no side predominance, and no side predominance is observed on objective examination

PD drug

- **Severe motor symptom -> levodopa**
- **Mild to Moderate motor symptoms**
  - **age>60**
    - **levodopa**
  - **age<60 ไม่ต้องการ motor complication, monoTx is best**
    - **DA agonist (non-ergot** > ergot)
    - **MAOBi:** selegyline, rasagyline
    - **(COMTi (entacapone) must combine with L-dopa)**
    - (**Anti-cholinergic: <50yr, ADR:confusion, dementia**, good in early stage and tremor predominate)

Secondary Parkinsonism

- Infection
  - Encephalitis : AID, PML
  - Prion
  - Neuro SY
  - Toxoplasmosis
- Trauma
  - Brain trauma
  - Chronic SDH
- Brain tumor
- NPH
- Vascular: Stroke, AVM
- Drug
  - **DA blocker**
  - **Antipsychotic: phenothiazine, risperidone, olanzapine**
  - **antivertigo: flunarizine, cinnarizine**
  - Depakene
  - Cyanide, Mn, CO
- Metabolic
  - Familial BGG calcification
  - Wilson
  - Huntington
  - Hypoxemia
  - SCA mutation
  - Chronic liver failure

Acute parkinsonism

Cause	Example
Medication	• **Antipsychotic drug** • **Antiemetic agents** • Chemotherapeutic • Other: SSRI, bupropion, Li, VPA, amiodarone, captopril, amlodipine, **flunarizine, cinnarizine**
Infectious and post infectious	• JE virus, HIV, Coxackie • Westnile

Structural	• **Injury to nigrostriatal pathway**
	  • **Stroke**
	  • Tumor
	  • Aqueductal stenosis

Toxic	• Pesticides, methanol, CO
Psychiatric	• Catatonia
Metabolic	• Extrapontine myelolysis

Drugs induced Parkinsonism (DIP)

- Symptoms occur **within one month of starting or increasing dose**
- Static but may **persist**
- **Symmetrical** (may be asymmetrical)
  - **Akinesia and bradykinesia: common**
  - Tremor: postural **(rarely resting)**
- Risk factors
  - Elderly woman
  - FHx of PD

- **Treatment**
  - **Symptomatic Rx: levodopa, dopamine agonist**
    - Taper dose and stop levodopa if improved
    - Impaired swallowing: apomorphine
- **Most: improve over months**

Drug induced parkinsonism

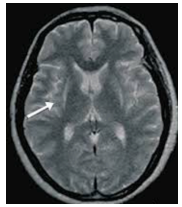
PD plus

- **MSA: autonomic disturbance (impotence, urinary incontinence, orthostatic hypotension), cerebellar sign (MSA-C)**
- **DLB: dementia + recurrent visual hallucination, fluctuation cognition**
- **PSP: ophthalmoplegia (limit downward gaze), frequent falling(postural instability), symmetry, retrocolis**
- Corticobasal degeneration (CBD): dementia + Alien hand syndrome, less tremor, cortical sensory loss

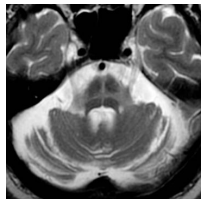
MSA

	Autonomic dysfunction	Parkinsonism	Cerebellar dysfunction
MSA	++++	+	+
MSA-P	++++	++++	+
MSA-C	++++	+	++++
Other features	• Sometimes asymmetry • Predominant AUTONOMIC (Orthostatic hypoT >30/15, ED, urinary incontinence) • Non-motor: stridor, dysphonia, OSA, mood, RBD • Anterocollis / camptocormia • Hyperreflexia and BBK sign • 40% response to L-Dopa		

MSA-P: Putaminal rim sign (T2)

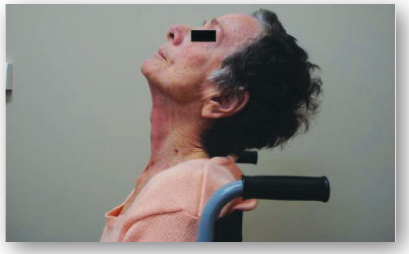


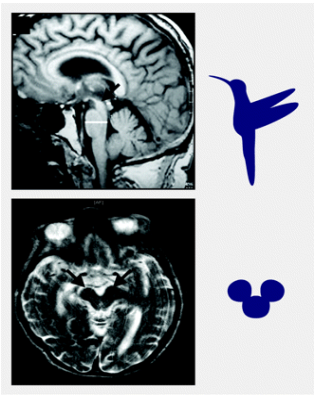
MSA-C: Hot cross bun sign (T2)



Progressive supranuclear palsy (PSP)

- Begins with falls and vertical supranuclear gaze paresis and progresses to symmetrical rigidity and dementia.
- Retrocollis
- Pseudobulbar palsy
- Procerus sign, starring gaze
- Applause sign





MRI brain in patient with PSP, showing characteristic **"hummingbird sign"** and **"Mickey Mouse"** at midbrain.

Progressive supranuclear palsy (PSP)

Outline

- **Problems**
  - Paraparesis
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  - Diplopia
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  - Proximal weakness
  - Seizure
  - Parkinsonism
  - **Stroke**
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Standard Treatment of AIS

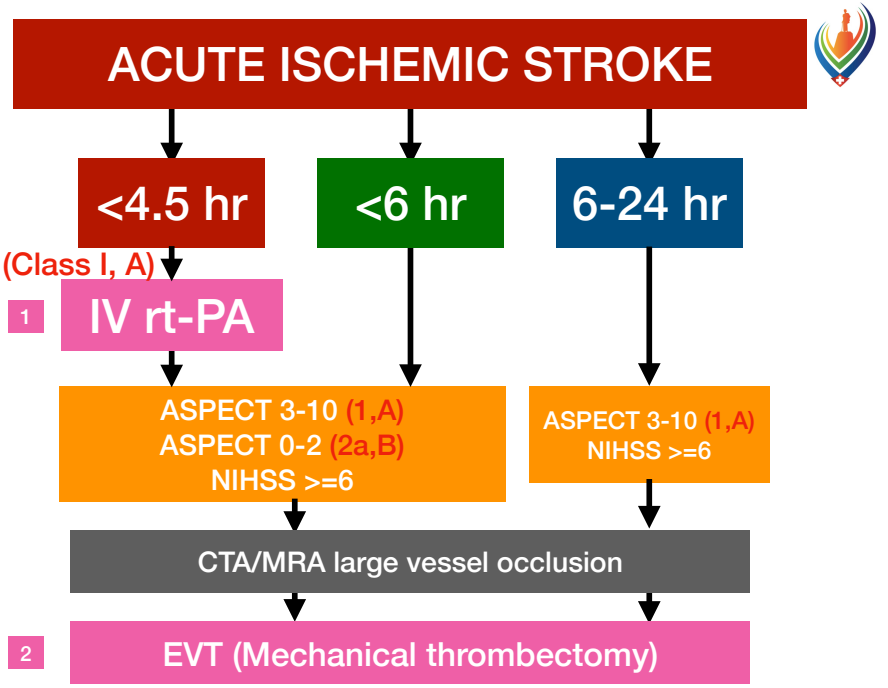
Stroke unit : Care in stroke unit

IV rt-PA for AIS within 4.5 hrs

Mechanical Thrombectomy for large vessel occlusion (within 24 hrs)

Aspirin administration in the first 48 hrs

Early hemicraniectomy in malignant MCA infarction

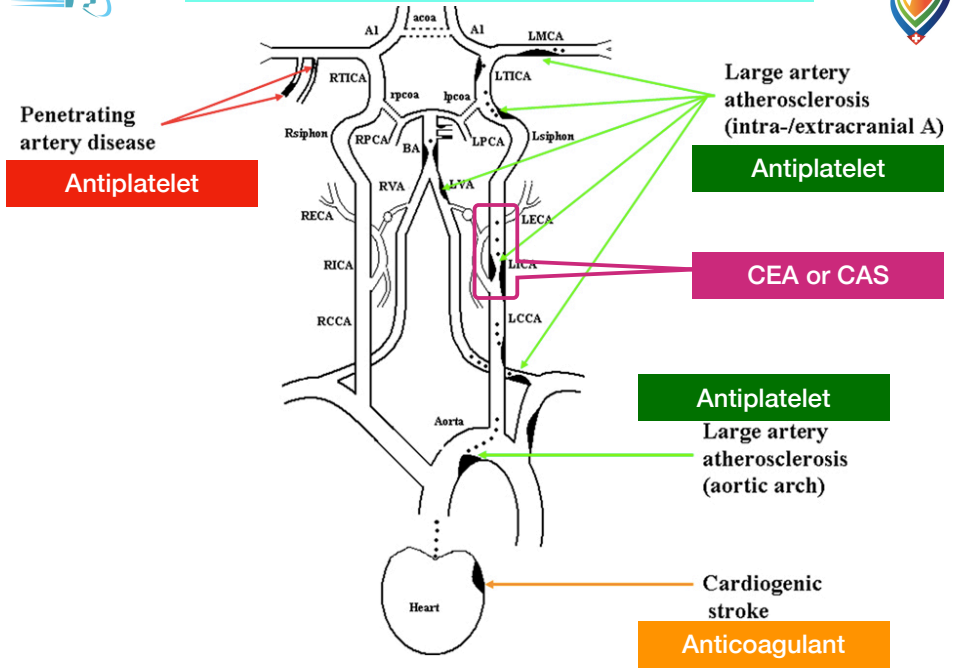


Prabhakaran S, et al. 2026 Guideline for the Early Management of Acute Ischemic Stroke. *Stroke*. 2026.

TOAST classification

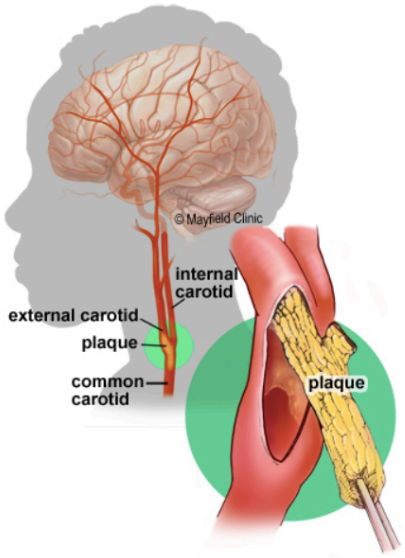
	Clinical	Radiological	Other
Large-artery atherosclerosis	Signs of lesion in cortex (aphasia, apraxia, neglect), subcortex, cerebellum, or brainstem	–CT/MRI shows lesion >1.5 cm in cortex, subcortex, cerebellum, or brainstem compatible with the symptoms. –CT scan negative when performed shortly after onset	Color duplex images of precerebral arteries shows stenosis ≥50% or occlusion in symptomatic major intracranial/ extracranial artery
Cardio-embolic	Signs of lesion in cortex (aphasia, apraxia, neglect), subcortex, cerebellum, or brainstem	–CT/MRI shows lesion >1.5 cm in cortex, subcortex, cerebellum, or brainstem compatible with the symptoms. –CT scan negative when performed shortly after onset	ECG/TEE confirm high risk / medium high risk of cardio-embolic source
Small-vessel disease	Clinical signs of a lacunar syndrome (pure motor, pure sensory, sensori-motor, atactic hemiparesis, or dysarthria-clumsy hand syndrome)	–CT/MRI shows lacunar infarction (lesion <1.5 cm) compatible with the symptoms. –CT scan negative when performed shortly after onset	No large vessel disease or cardio-embolic disease identified in color duplex images of precerebral arteries or in ECG/TEE
Other determined			Other abnormality on tests
Undetermined	1. Two or more causes identified 2. Negative evaluation 3. Incomplete evaluation		

Different etiology : different secondary prevention



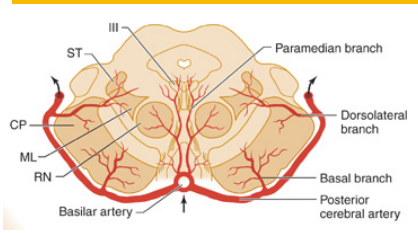
Carotid Endarterectomy (CEA) or Caratid Artery Stenting (CAS)

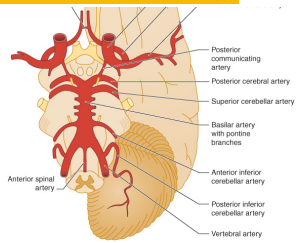
- **Extracranial** carotid artery
- **Symptomatic** stenosis
- **Severe** stenosis (70-99%)
- Pre-op Good **mRS**
- Within **2 weeks** is the best
- **CTA** or **MRA**
  or Carotid duplex (**CDUS**)



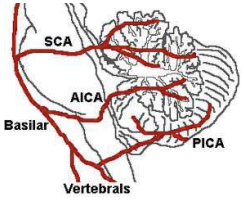
Brain Stem Syndrome

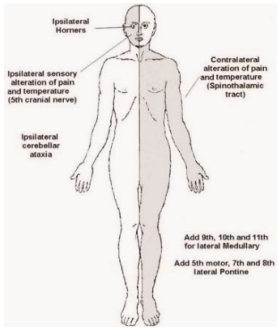
Medial syndrome	Lateral syndrome
Motor (contralateral)	**S**ensory (contralateral, PPS)
Medial lemniscus (contralateral VBS, proprioceptive)	**S**pinocerebellar tract (ipsilateral cerebellar sign)
MLF (ipsilateral INO)	**S**ympathetic pathway (ipsilateral Horner's syndrome)
Motor nucleus of CN 3,4,6,12 (ipsilateral)	**S**ensory nucleus of CN5 (ipsilateral facial sensory loss)
Penetraing brach of BA	PICA, AICA, SCA

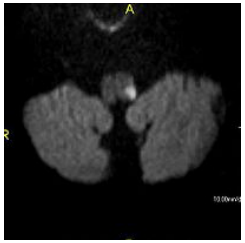


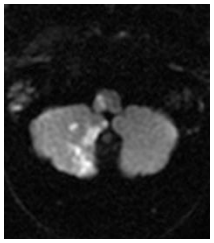


Wallenberg Syndrome



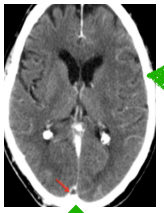




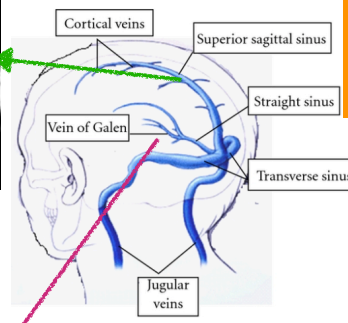


- **Wallenberg syndrome**
  - **Lateral medullary** syndrome or PICA infarction
  - Contralateral
    - Sensory loss of arm and leg spare face
  - Ipsilateral
    - Impair sensation of face
    - Ataxia of limb, nystagmus, nausea, vertigo
    - Horner's syndrome
    - Dysphagia, hoarseness, vocal cord paralysis (CN9,10,11)

Stroke in the young (<45)



Empty delta (CT contrast)



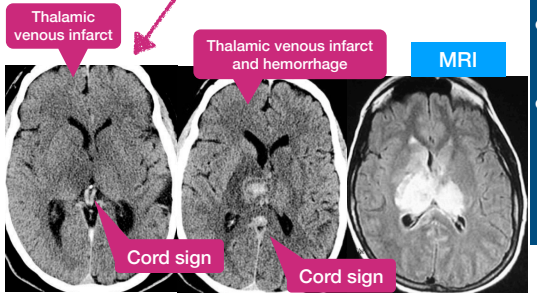
- Cancer (asso-hypercoag)
- Drug - pill
- Hypercoag
- Local infection

Arterial

Venous

Cerebral Venous Sinus Thrombosis

- MUST KNOW
  - SSS thrombosis
  - Deep venous system thrombosis (Internal cerebral vein or Galen)
- SS
  - Headache + Stroke like +Seizure
- Rx
  - Workup hypercoagulable state
  - Anticoagulation despite hemorrhage
    - Duration according to cause



Stroke in the young (<45)

- **Arterial**
  - **Vasculopathy**
    - Inflam
      - Infection
        - SY, CNS-TB
        - VZV, HIV
      - Inflammation
        - 1ry vasculitis: TA (GCA), Behcet's, PAN
        - 2ry vasculitis: SLE
    - Non-inflam
      - Premature atherosclerosis
      - Post-RT
      - FMD
      - Homocysteinemia
      - Dissection
      - Vasospasm: cocain, amphet, heroin, cannabinoid
      - MoyaMoya
        - 1ry genetic
        - 2nd: NF, Down
  - **Blood component**
    - Cell
      - RBC: PV
      - WBC: CML
      - PLT: ET
    - Hypercoagulable
      - APL
      - Inherited eg. prot C/S def
      - Pill
  - **Embolic**
    - Arrhythmia: AF, SSS
    - Structural:
      - Mechanical valve
      - LA/LV thrombus
      - Recent MI (<4mo)
      - DCM (EF<35%)
      - IE, Libmann-sack
      - Atrial myxoma
      - PFO
    - Mixed: MS with AF

- LAA 2-11%
- SVD 7-14%
- Cardioembolic 20-74%
- Other determined etiology (20-34%)
- Multiple etiologies (2-3%)

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  - Paraparesis
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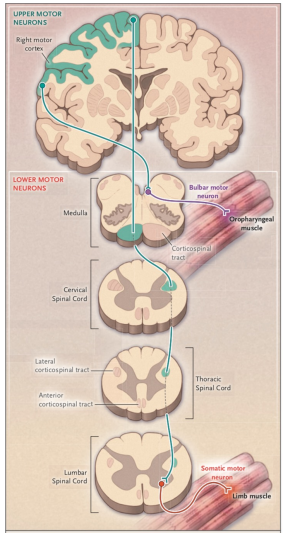
  - Parkinsonism
  - Stroke
  - **Motor neuron disease**
- **Miscellaneous**
  - Horner's syndrome
  - Parinaud's syndrome
  - Wilson's disease

Anatomy

- **Motor neuron disease : degeneration of motor neuron**
  - Upper motor neuron
    - motor cortex : primary motor neurons and premotor areas
    - corticospinal and corticobulbar tracts
  - Lower motor neuron : send out motor axon to innervate skeletal muscle
    - Anterior horn cell (located in spinal cord)
    - Motor nuclei of cranial nerves (located in brainstem)



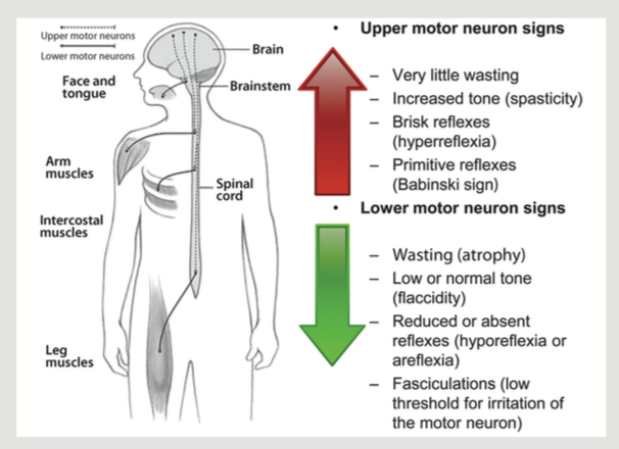
N engl j med 377;2, 2017

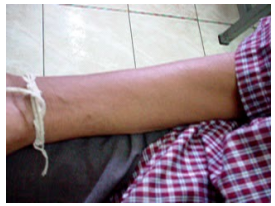
Motor neuron disease

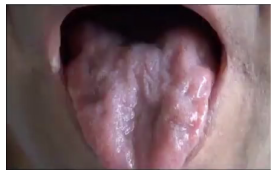
- **MND includes a spectrum of clinical syndromes that result from degeneration of UMN, LMN, or both**

UMN	LMN	UMN + LMN
• Primary lateral sclerosis (PLS)	• Progressive muscular atrophy	• ALS
• Hereditary spastic paraparesis (HSP)	• Spinal muscular atrophy	• ALS-FTD
• Adrenomyeloneuropathy	• Spinobulbar muscular atrophy (SBMA or Kennedy disease)	• ALS parkinsonian complex of Guam
• HTLV	• Poliomyelitis/ Post polio syndrome	• Machado-Joseph disease
	• Hirayama disease	• Paraneoplastic disease
	• Flail arm syndrome	
	• Postradiation LMN syndrome	
	• Paraneoplastic disease	

Clinical manifestation





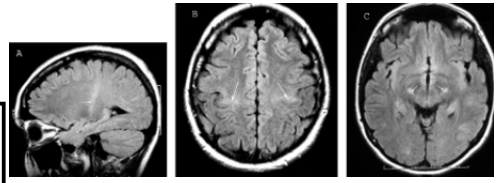


Continuum (Minneap Minn) 2014;20(5)

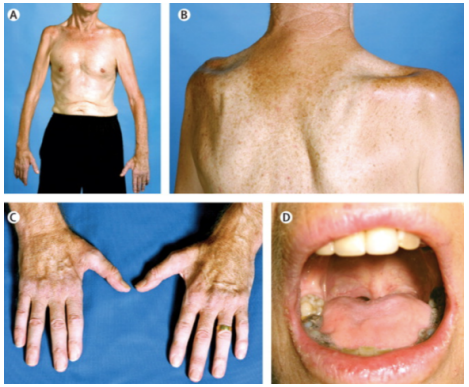
ALS

- SS: male, 40-50 yo, survival 2-4y

Typically present with **bulbar or asymmetric limb weakness**, more prominent in **distal** than in proximal muscles, **without significant sensory or sphincter abnormalities**

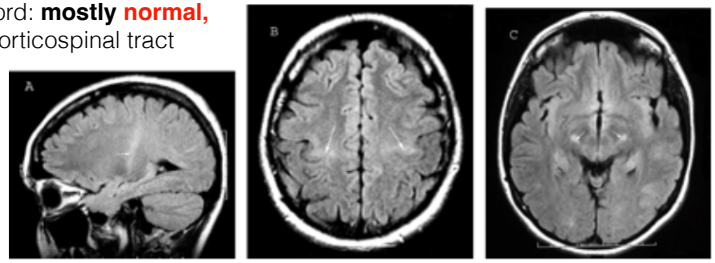


- **Mixed LMN/UMN in same region**
  - **LMN**: Dec DTR/palate/gag, fasciculation, atrophy (LMN of BS and SC)
  - **UMN**: Hyperreflexia, BBK, spastic, cramp
- Dx
  - Both UMN and LMN findings in the bulbar and at least 2 spinal regions (C, T, LS)
  - EMG: fibrillation and fasciculation, NCV: normal
  - **MRI** Brain and cord: mostly normal, hyperT2/ FLAIR corticospinal tract



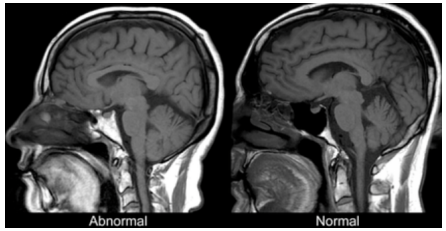
MRI in ALS

MRI Brain and cord: **mostly normal,** hyperT2/FLAIR corticospinal tract



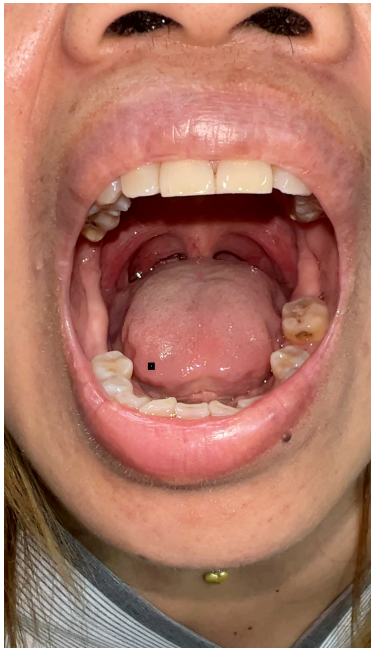
- **Axial FLAIR image:** hyperintensity of precentral gyrus bilaterally involve corticospinal tract at the crus cerebri.
- This series of MR images clearly demonstrated **bilateral corticospinal tract involvement**

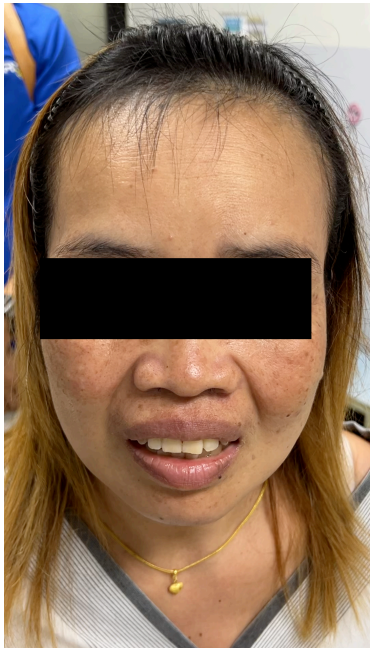
"Bright tongue sign" in ALS



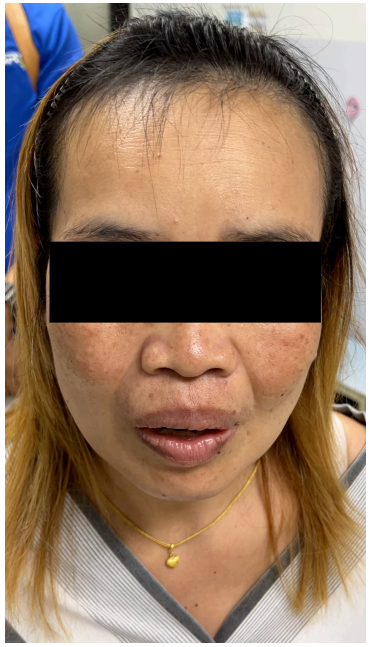
diffuse T1 hyperintensity of the tongue musculature (left)

ALS

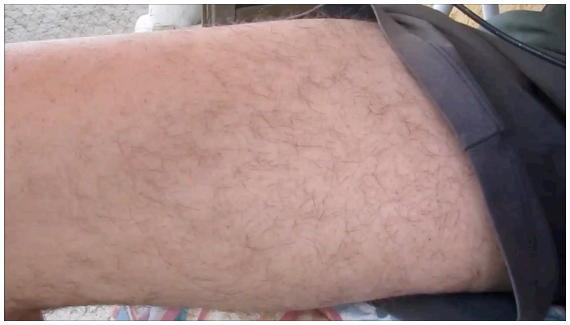


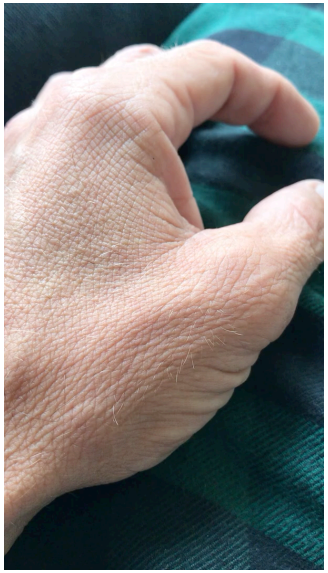


ALS



Limb Fasciculation





ALS : Treatment

- **Riluzole (FDA approved, 1996)**
  - Disease-modifying drug treatment
  - **reduce glutamate by blocking voltage-gated sodium channel** on presynaptic neuron
  - advantage of **2 to 3 months survival benefit** has been shown (9% increase in 1-year survival)
- **Edavarone (FDA approved, 2017)**
  - **Potent antioxidant and strongly scavenges free radicals**, protecting against oxidative stress and neuronal apoptosis
  - **Slow disease progression in early onset and rapidly progressing disease**

Current Medicinal Chemistry, 2010, 17
Lancet Neurol 2017; 16: 505–12

Motor neuron disease

- **MND includes a spectrum of clinical syndromes that result from degeneration of UMN, LMN, or both**

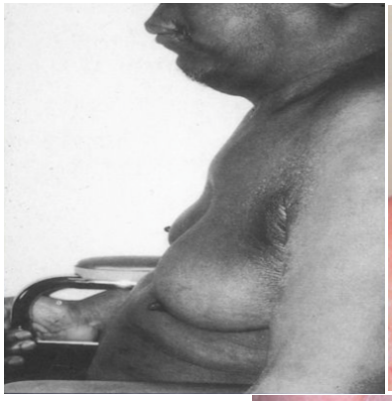
UMN	LMN	UMN + LMN
• Primary lateral sclerosis (PLS)	• Progressive muscular atrophy	• ALS
• Hereditary spastic paraparesis (HSP)	• Spinal muscular atrophy	• ALS-FTD
• Adrenomyeloneuropathy	• **Spinobulbar muscular atrophy (SBMA or Kennedy disease)**	• ALS parkinsonian complex of Guam
• HTLV	• Poliomyelitis/ Post polio syndrome	• Machado-Joseph disease
	• Hirayama disease	• Paraneoplastic disease
	• Flail arm syndrome	
	• Postradiation LMN syndrome	
	• Paraneoplastic disease	

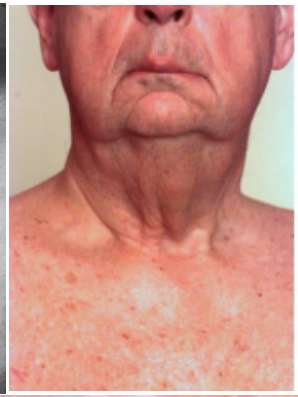
Kennedy Disease

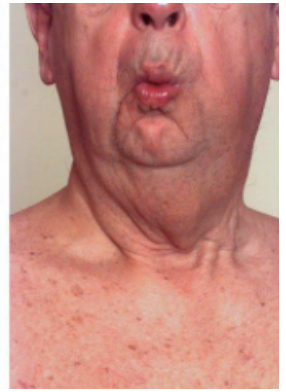
(X-Linked Recessive Bulbospinal Neuronopathy or Spinobulbar muscular atrophy: SBMA)

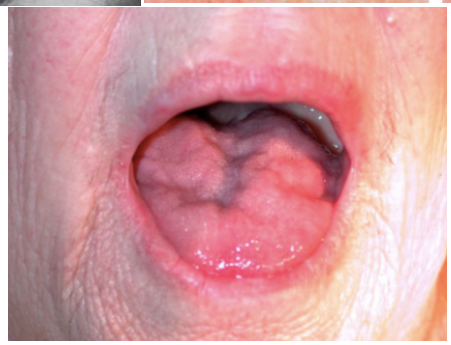
- **XR, Mutation of androgen receptor in X-chrm**
  - X-linked disorder associated with a t**rinucleotide repeat** in the first exon of the **androgen receptor gene:** cytosine-adenine-gaunine **(CAG) repeats > 38**
- **Rare 1:400,000, normal life span, male, onset 30-50 yrs**
- Degeneration of **motor and sensory neuron** supplying **limb and bulbar**
  - **Androgen rct mutation:** male phenotype with infertility, ***gynecomastia*** and undervirilization, ***testicular atrophy***
  - **Spino: postural TREMOR (Upper limb),** insidious onset muscle cramp, fatigue **and waekness- prox>distal** (+- sensory loss) then wheelchair bound
  - **Bulbar**: **dysarthria, nasal voice, dysphagia, facial weakness, **TONGUE and PERIORAL FASCICULATION (quivering chin phenomenon)**
- Associated symptoms: **endocrinopathy (DM,hypothyroid), cardiomyopathy, DLP**

Rev Neurol (Paris). 2017 May;173(5)



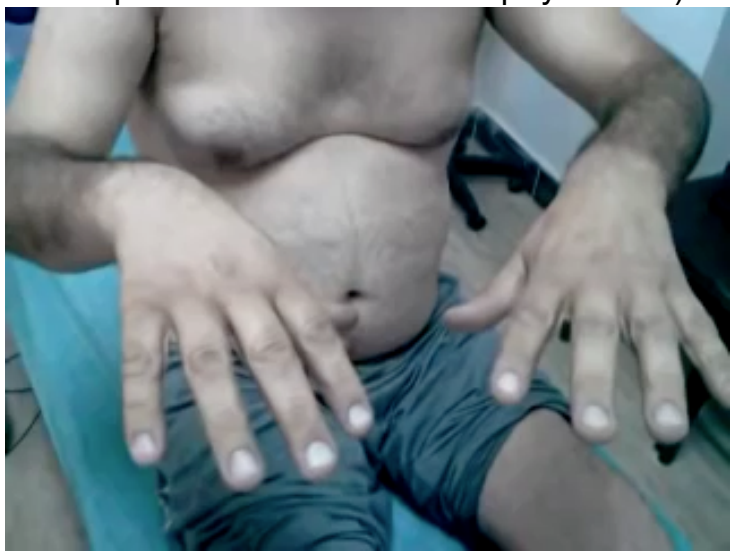






Kennedy Disease

(X-Linked Recessive Bulbospinal Neuronopathy or Spinobulbar muscular atrophy: SBMA)



Kennedy Disease

(X-Linked Recessive Bulbospinal Neuronopathy or Spinobulbar muscular atrophy:SBMA)

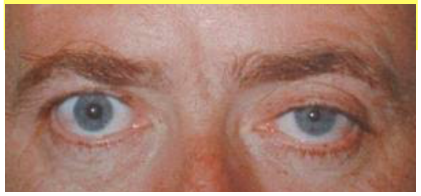
- **Diagnosis**
  - Gold standard: genetic test the **CAG expansion number in the AR gene** (>38 repeats -> pathologic)
  - **Very high CPK** (38xnormal value)
  - **EMG**: **chronic neurogenic pattern with fasciculation**, diminution of the amplitude of sensory action potentials
- **Treatment**
  - No effective disease-modifying therapy is available
  - Symptomatic therapy

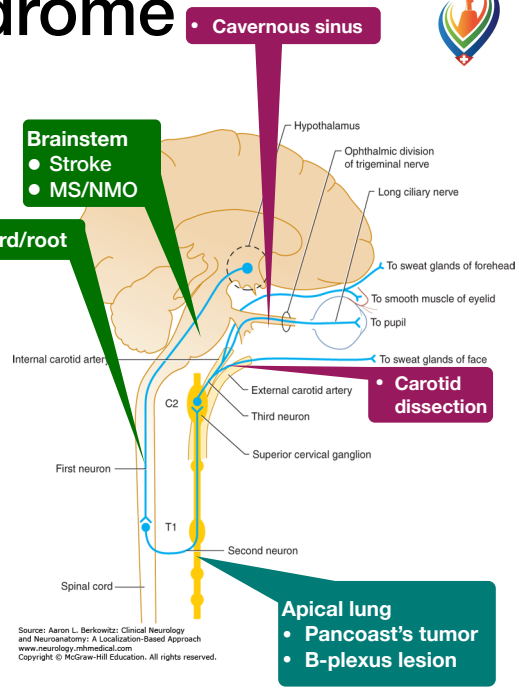
Outline

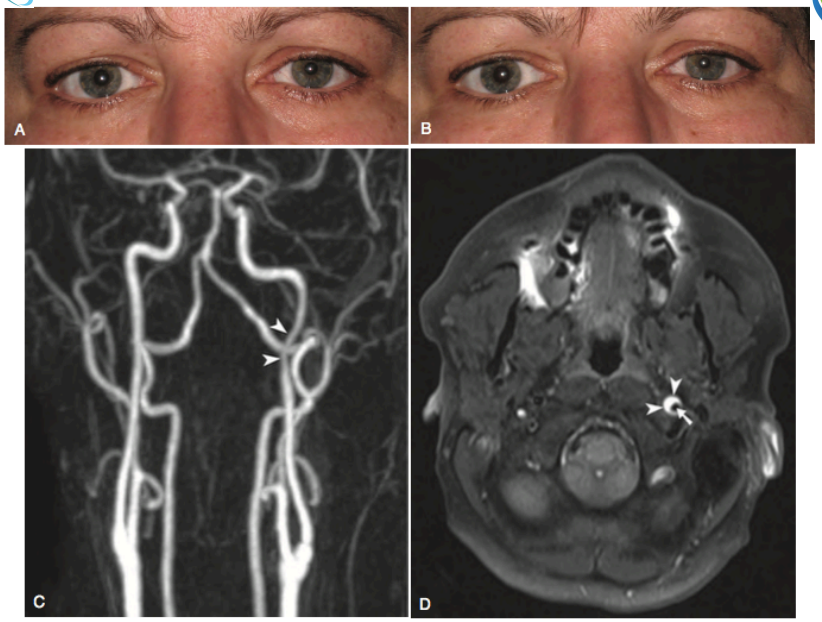
- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - **Horner's syndrome**
  - Parinaud's syndrome
  - Wilson's disease

Horner's Syndrome

- 1st order (central)
  - hypothalamus + brainstem + SC
  - เหงื่อหายครึ่งซีกทั้งตัว
- 2nd order (preganglionic)
  - cervical gg. (apical lung/ thyroid CA)
  - เหงื่อหายใบหน้าครึ่งซีก
- 3rd order (postganglionic)
  - carotid a., cavernous sinus
  - ถ้า lesion อยู่ distal to carotid bifurcation) เหงื่อหายครึ่งซีกเฉพาะหน้าผาก







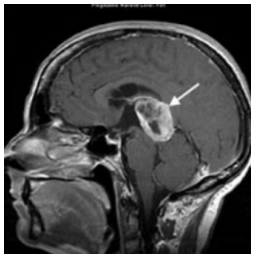
Outline

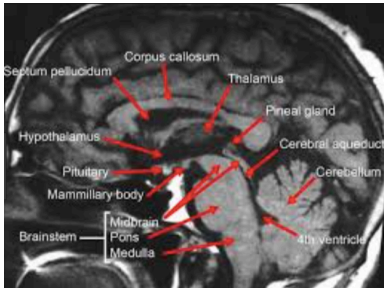
- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - **Parinaud's syndrome**
  - Wilson's disease

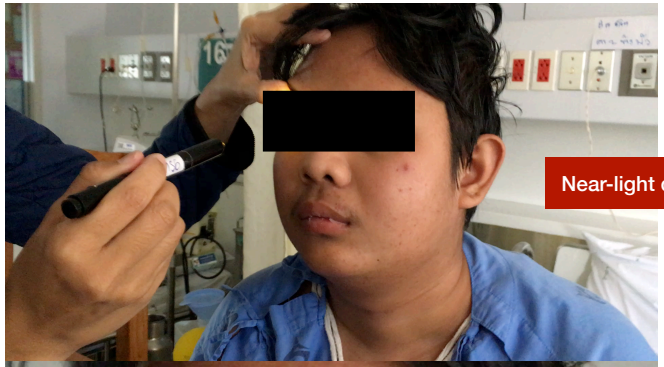
Parinaud's Syndrome

- Upward gaze palsy
- Light near dissociation
- Collier's sign (lid retraction)
- Convergence retraction nystagmus (co-contraction)

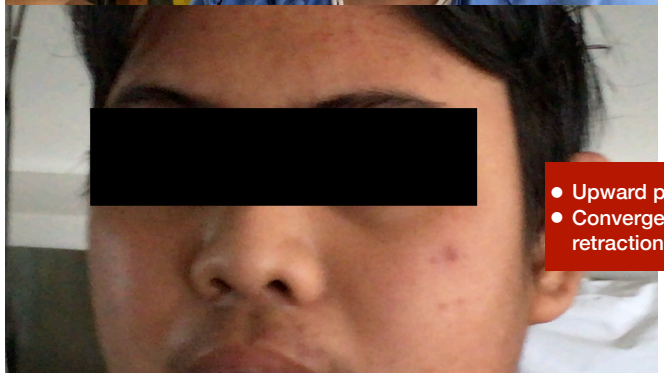
- Dorsal midbrain syndrome
- Cause
  - Mass at pineal region : GCT
  - Hydrocephalus (3rd ven)
  - MB infarction
  - Demy (MS/NMO)







Near-light dissociation



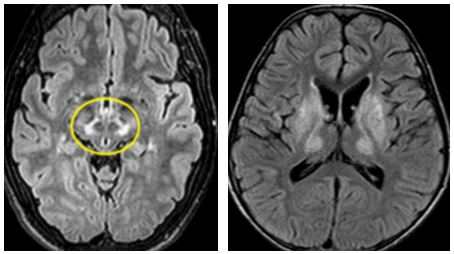
- Upward palsy
- Convergence retraction nystagmus

Outline

- **Problems**
  - Paraparesis
  - Ataxia
  - Diplopia
  - Multiple Cranial Neuropathy
  - Peripheral Neuropathy
  - Proximal weakness
  - Seizure
  - Parkinsonism
  - Stroke
  - Motor neuron disease
- **Miscellaneous**
  - Horner's syndrome
  - Parinuad's syndrome
  - **Wilson's disease**

Wilson's Disease

- AR, ATB7B mutation
- Cu accumulation
- SS: Neuropsychi + Eye + GI
- Dx:
  - Cu, ceruloplasmin, Urine Cu
  - Eye: KF ring
  - Liver Bx
- Rx:
  - Chelate: D-pen, trientine
  - Zinc
  - Liver transplantation



Panel 1: Clinical manifestations of Wilson's disease

Hepatic
- Persistently elevated serum aminotransferases
- Chronic hepatitis
- Cirrhosis (decompensated or compensated)
- Fulminant hepatic failure (+/- haemolytic anaemia)

Neurological
- Tremor
- Choreiform movements
- Parkinsonism or akinetic rigid syndrome—ie, partial parkinsonism
- Gait disturbances
- Dysarthria
- Pseudobulbar palsy
- Rigid dystonia
- Seizures
- Migraine headaches
- Insomnia

Ophthalmic
- K-F rings
- Sunflower cataracts

Psychiatric
- Depression
- Neuroses
- Personality changes
- Psychosis

Other systems (rare)
- Renal abnormalities: aminoaciduria and nephrolithiasis

Lancet. 2007;369(9559):397–408.

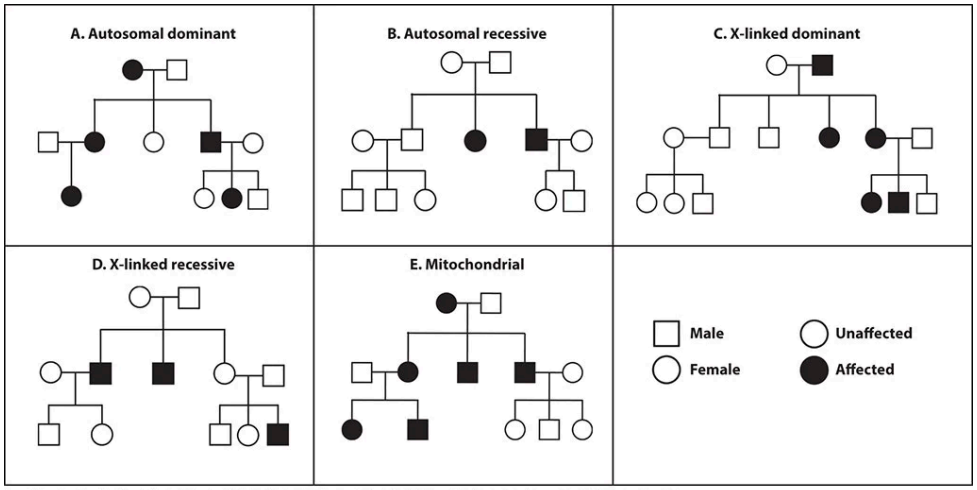
Neurological Approach

In Long Case Examination

Wisan Teeratantikanon, MD, FRCP(T)

Neurology Unit, Maharat Nakhon Ratchasima Hospital

Mode of inheritance



Source: David DiTullio, Esteban C. Dell'Angelica: *Fundamentals of Biochemistry: Medical Course and Step 1 Review*
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Neurogenetic Diseases

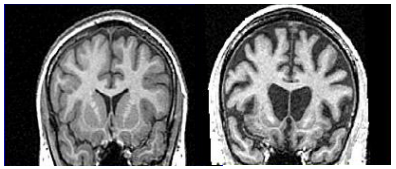
- **Trinucleotide repeat expansion-related diseases** (Anticipation : instability and increase in repeated expansion in later generation - earlier age of onset)
- **Inherited ataxias**
- Ion channel disorders
- Mitochondrial genetics
- Neurodegenerative disorders: genetic Parkinson's disease

Trinucleotide repeat expansion-related diseases

- Huntington's disease (AD)
- **Inherited ataxias** eg. SCA1 (AD)
- Myotonic dystrophy (AD)
- **X-linked spinobulbar muscular dystrophy (Kennedy's disease : XR)**
- Oculopharyngeal muscular dystrophy (OPMD: AD)
- Fragile X syndrome

Huntington's disease

- **AD**, Huntingtin gene **(HTT)**
- **CAG repeat** related disorder > 36 repeats
- Symptoms
  - **Neuro: chorea, cognitive impairment**
    - Chorea : start at upper extremities > face > legs (distal>proximal)
    - Cognitive impairment : subcortical dementia
  - **Psychi: depression**, mania, bipolar, apathy, psychosis)
- **Treatment**
  - **Symptomatic** (chorea): **haloperidol**, tetrabenazine, chlorpromazine, atypical antipsychotic
  - **Genetic advice** : ไม่ควรตรวจในผู้ไม่บรรลุนิติภาวะ และไม่แนะนำให้ทำ prenatal diagnosis
  - Drugs under study: Caspase inhibitor (minocycline), CoQ10



Normal HD

Inherited Ataxias

- Disorders of coordination of muscle movement from cerebellar degeneration
  - Ataxia
  - Dysmetria
  - Ataxic dysarthria , slurred speech
  - Nystagmus

SCA in Thailand

Table 2 Comparison of clinical profile and features of unrelated Thai patients with SCA1, SCA2, MJD and SCA6

	SCA1	SCA2	MJD	SCA6	*p*-value*
Total numbers	21	15	39	8	
Sex (M/F)	11/10	8/7	14/25	4/4	0.500
Age at onset (years)					
Mean age at onset	38.43	41.47	39.97	43.5	0.715
SD	10.14	13.01	12.17	6.76	
Range	15 – 55	19 - 60	16 - 64	34 - 58	
Duration (years)					
Mean duration	5.43	3.93	6.62	6	0.328
SD	5.13	2.99	5.01	5.90	
Range	1 - 20	1 - 10	0.25 - 22	1 - 18	
Positive family history (%)	16 (76.2)	13 (86.7)	32 (82.1)	7 (87.5)	0.900
CAG repeat size (repeats)					
Mean	50.14	37.40	69.97	21.88	
SD	6.27	4.47	4.04	0.83	
Range	41 – 65	32 - 52	62 - 78	21 - 23	
Clinical features (%)					
Slow saccade	12 (57.1)	7 (46.7)	21 (53.9)	2 (25)	0.454
Horizontal nystagmus	5 (23.8)	4 (26.7)	34 (87.2)	6 (75)	**0.0000002****
Vertical nystagmus	0 (0)	1 (6.7)	6 (15.4)	3 (37.5)	**0.026****
Opthalmoparesis	6 (28.6)	3 (20.0)	26 (66.7)	2 (25)	**0.002****
Pale optic disc	1 (4.8)	0 (0)	2 (5.1)	1 (12.5)	0.610
Hyperreflexia	19 (90.5)	5 (33.3)	26 (66.7)	7 (87.5)	**0.002****
Babinski's sign	11 (52.4)	5 (33.3)	17 (43.6)	5 (62.5)	0.510
Areflexia	0 (0)	5 (35.7)	9 (23.1)	0 (0)	**0.011****
Sensory impairment	4 (19.0)	3 (20.0)	9 (23.1)	0 (0)	0.630
Parkinsonism	0 (0)	0 (0)	0 (0)	0 (0)	1.000
Dystonia	1 (4.8)	0 (0)	1 (2.6)	0 (0)	0.475
Chorea	0 (0)	0 (0)	1 (2.6)	0 (0)	1.000
Dementia	0 (0)	1 (6.7)	0 (0)	1 (12.5)	0.074
Facial fasciculation	2 (9.5)	0 (0)	5 (12.8)	0 (0)	0.579
SARA					
Mean scale	16.97	13.18	16.76	15.71	0.767
SD	7.45	3.66	7.27	7.24	
Range	4 - 30	9 - 20	8 - 35	3.5 - 27	

*Continuous variables were analyzed by using ANOVA. Comparisons of frequencies of clinical profiles and features were analyzed by using Fisher's exact test.
**P < 0.05 is considered as significant difference.
Abbreviations as follows: SCA spinocerebellar ataxia, *MJD* Machado-Joseph disease, *SD* standard deviation, *SARA* scale for the assessment and rating of ataxia.

Boonkongchuen et al. BMC Neurology 2014, 14:75

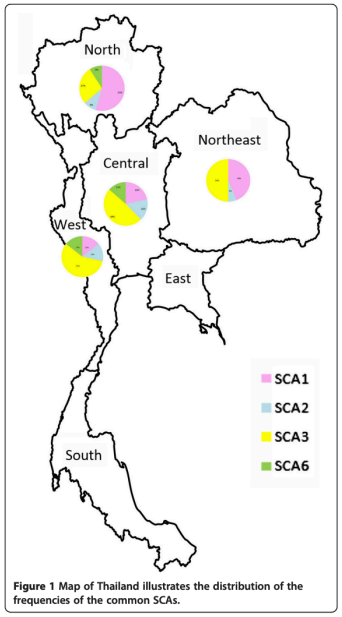


Figure 1 Map of Thailand illustrates the distribution of the frequencies of the common SCAs.

Neurological Approach
In Long Case Examination

Wisan Teeratantikanon, MD, FRCP(T)
Neurology Unit, Maharat Nakhon Ratchasima Hospital