

Pearls and pitfalls in imaging of Parkinsonism

- A practical guide for radiologists



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Introduction

Parkinson plus syndrome (PPS) refers to a group of neurodegenerative disorders that clinically mimics Parkinson disease (PD). Conventional treatments for PD such as Levodopa and deep brain stimulation were shown to have poor response or even disabling clinical deterioration in PPS.

A better understanding of the common imaging patterns in both structural and functional imaging of Parkinsonism is essential to radiologists for correct diagnosis of each individual PPS, which bears important treatment and prognostic implications.

Diagnostic work-up of Parkinsonism

Structural Imaging

Computed tomography
Magnetic resonance imaging
(+/- Automated brain volumetry
e.g. AccuBrain™)

Functional Imaging

FDG-PET
Amyloid-PET
¹²³I ioflupane SPECT

Parkinson disease

Clinical presentation

Resting tremor, rigidity, bradykinesia, postural instability

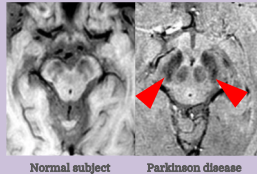
MRI

Absent swallow tail sign (arrows)

- Loss of hyperintense nigrosome-1 at substantia nigra on SWI images

FDG PET

- Usually normal, i.e. preserved putaminal activity



Clinical difference between PD and PPS

	Parkinson disease	Atypical Parkinsonism
Symptomatology	Resting tremor, rigidity, bradykinesia, postural instability	Early speech and balance problem, early dementia, early autonomic dysfunction
Response to Levodopa	Yes	No
Response to deep brain stimulation	Yes	No response or may even have clinical worsening

MRI Protocol for Investigating Parkinsonism

Whole brain

3D T1
Axial T2
Coronal FLAIR

Brainstem

Axial T2 fine cut
Basal ganglia to brainstem
High resolution SWI

Progressive supranuclear palsy (PSP)

Clinical presentation

Vertical gaze palsy, postural instability, speech disturbances

MRI

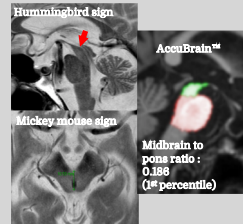
- Hummingbird sign (arrow)
- Mickey mouse sign (reduced AP midbrain diameter <12mm)

FDG PET

- Hypometabolism at midbrain

Automated brain volumetry (AccuBrain™)

- Reduced midbrain to pons area ratio on midline sagittal plane (normal ratio: 1/4)



Multisystem atrophy - parkinsonism type (MSA-P)

Clinical presentation

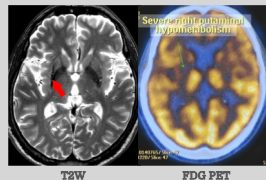
Predominant Parkinsonism symptoms and signs

MRI

- Atrophy and/or T2 hypointensity at posterior putamen (arrow)
- "Slit-like" marginal T2 hyperintensity (1.5T MRI)

FDG PET

- Hypometabolism at putamen



Multisystem atrophy - cerebellar type (MSA-C)

Clinical presentation

Predominant cerebellar ataxia

MRI

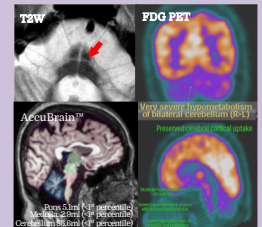
- Atrophy of pons, medulla and cerebellum
- Hot cross bun sign (arrow)

FDG PET

- Hypometabolism at cerebellum and pons (right upper and lower images)

Automated brain volumetry (AccuBrain™)

- Reduced volume of pons, medulla and cerebellum



Corticobasal degeneration (CBD)

Clinical presentation

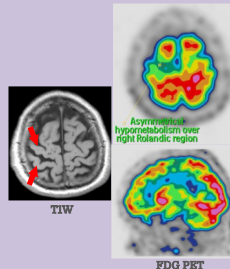
Apraxia, dystonia, postural instability and akinetic-rigid syndrome

MRI

- Asymmetrical cerebral atrophy at perirolandic gyri contralateral to clinically affected sign (arrow)
- Subcortical white matter T2 hyperintensity
- Asymmetrical basal ganglia atrophy

FDG PET

- Hypometabolism at atrophic perirolandic region and basal ganglia



Lewy body dementia (LBD)

Clinical presentation

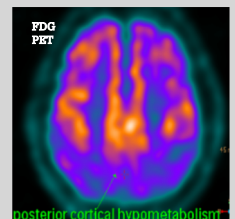
Fluctuating cognition, recurrent visual hallucinations and parkinsonism

MRI

- Occipital lobe atrophy
- Absent swallow tail sign

FDG PET

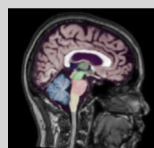
- Occipital lobe hypometabolism



Brain volumetric analysis (AccuBrain™)

- AccuBrain™** is a clinically applicable computing tool for **early detection** of neurodegenerative disease. It allows anatomical segmentation and **volumetric analysis** of whole brain in a **fully automated** way, within a short time, based on the MRI images.

- It has a promising future to act as an **ancillary tool** in evaluation of patients with parkinsonism.



Teaching Points

- Clinical diagnosis of individual parkinsonian disorder is challenging due to **overlapping symptoms**.
- Recognition of characteristic **structural and functional imaging features** of Parkinsonism by multimodality imaging including **MRI (+/- assistance by brain volumetric analysis)** and **FDG-PET** is essential to guide proper diagnosis which bears **important treatment and prognostic implications**.