Role of Diagnostic Imaging in Dementia

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Examples of Dementing Disorders

• **Neurodegenerative Diseases**
  Alzheimer’s disease (AD)
  Dementia with Lewy bodies (DLB)
  Frontotemporal dementia (FTD)
  Other atypical neurodegenerative disorders

• **Acquired Brain Disorders**
  Vascular dementia
  Intracranial neoplasms, trauma
  Hydrocephalus
  Encephalitis (e.g., Creutzfeldt-Jakob, paraneoplastic)
  Multiple sclerosis
  Infection, metabolic, endocrine disorders
### Therapeutic Implications

<table>
<thead>
<tr>
<th>Condition</th>
<th>ChE Inhibitor</th>
<th>Neuroleptics</th>
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<tbody>
<tr>
<td>Alzheimer’s disease (AD)</td>
<td>Good</td>
<td>Applicable</td>
</tr>
<tr>
<td>Dementia with Lewy bodies (DLB)</td>
<td>Excellent</td>
<td>Adverse reaction</td>
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<tr>
<td>Frontotemporal Dementia (FTD)</td>
<td>No effect</td>
<td>Applicable</td>
</tr>
<tr>
<td>Vascular Dementia (VaD)</td>
<td>Risk factor / vascular management</td>
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Dementia Clinical Workup

• Interview with patient / family member
• Physical examination
• Neurological examination
• Mental status examination (MMSE)
• Assessment for functional status
• Laboratory tests (e.g., CBC, thyroid, B12)
• Neuropsychological examination
• **Neuroimaging** (CT or MRI, PET or SPECT)
• EEG, lumbar puncture (when required)
• Genetic test (e.g., APOE) - not clinically accepted
Roles of Imaging in Dementia Care

- Excluding structural abnormalities: CT / MRI
- Differential diagnosis
- Early diagnosis: PET / SPECT / MRI
- Therapeutic trials
Magnetic Resonance Imaging (MRI)
MRI Findings in Dementia Patients

Cerebral infarction

Microvascular ischemia
Which patient has Alzheimer’s disease?
Molecular Imaging in Neurology Clinic 2017

Perfusion
CBF SPECT

Glucose
FDG PET

Dopamine
DAT SPECT

Amyloid
Amyloid PET
Imaging Local Brain Function with Emission Computed Tomography

David E. Kuhl, M.D.  Radiology 1984; 150: 625–631
Computer-Assisted Diagnosis of PET / SPECT

Original Images
Rotational Correction
Stereotactic Realignment
Anatomic Standardization
3D-SSP

Metabolic Reductions in Dementing Disorders

REF

AD mild

AD severe

DLBD

FTD

PSP

MID

NPH

Minoshima et al. 2002
Robin Smithuis, Radiology Department of the Rijnland Hospital, Leiderdorp, the Netherlands
Posterior Cingulate Cortex
Regional Vulnerability in Alzheimer’s Disease

AD
Minoshima, et al.
Lancet 1994

MCI
Minoshima, et al.
Ann Neurol 1997

APOE4
Reiman, et al.
New Eng J Med 1996
MCI: Prediction of Conversion to AD
Chet Mathis, ALZForum

Rowe CC and Villemagne VL J Nucl Med 2011;52:1733-1740
Imaging β-amyloid burden in aging and dementia
Neurology 2007;68;1718-1725
### Dementia with Lewy bodies vs. AD

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<tr>
<td>Alzheimer dementia</td>
<td><img src="image1" alt="Alzheimer brain" /></td>
<td><img src="image2" alt="Alzheimer brain" /></td>
<td><img src="image3" alt="Alzheimer brain" /></td>
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<tr>
<td>Lewy Body dementia</td>
<td><img src="image4" alt="Lewy Body dementia" /></td>
<td><img src="image5" alt="Lewy Body dementia" /></td>
<td><img src="image6" alt="Lewy Body dementia" /></td>
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Drzejga, Technical University of Munich
Appropriate use criteria for amyloid PET: A report of the Amyloid Imaging Task Force, the Society of Nuclear Medicine and Molecular Imaging, and the Alzheimer’s Association

Keith A. Johnson, Satoshi Minoshima, Nicolaas I. Bohnen, Kevin J. Donohoe, Norman L. Foster, Peter Herscovitch, Jason H. Karlawish, Christopher C. Rowe, Maria C. Carrillo, Dean M. Hartley, Saima Hedrick, Virginia Pappas, William H. Thies

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Division of Medical and Scientific Relations, Alzheimer’s Association, Chicago, IL, USA

Society of Nuclear Medicine and Molecular Imaging, Reston, VA, USA

Journal of Nuclear Medicine, published on January 28, 2013 as doi:10.2967/jnumed.113.120618
Appropriate Use of Amyloid PET

- Unexplained MCI, persistent and progressive
- Possible AD with an atypical clinical course or an etiologically mixed presentation
- Atypically early age of onset (65 years or less)
Amyloid-targeting Therapy

- Monoclonal antibodies
- $\beta$-secretase inhibitors
- $\gamma$-secretase inhibitors
- A$\beta$ fibril aggregation inhibitors
- A$\beta$ plasma clearance enhancer
- Active A$\beta$ vaccine
Amyloid PET Assessment of Therapy

Screening  Follow up (78 weeks)

Bapineuzumab

Rinne, Brooks, Rossor et al., Lancet Neurol 2010;9:363-372
Role of Imaging in Dementia Care

Summary

- Molecular imaging using nuclear technologies
- FDG PET, Amyloid PET, Perfusion SPECT, and Dopamine transporter SPECT
- Differential diagnosis
- Early diagnosis
- Therapeutic trials
Thank you