Assessment Driven Approach to Integrating Volumetric Software for MRI in Dementia

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Objectives

• To establish a dialogue regarding the interpretation of dementia imaging in our current practice

• To review the current literature on dementia imaging and volumetric software

• To assess the data presented from two separate leading vendors in Volumetric MR assessment

• To establish internal standards for how to incorporate the volumetric data into our MR interpretation to help guide clinical decision making
Introduction

• As the population ages, the overall burden of dementia is increasing worldwide. The most common form of dementia in older adults is Alzheimer’s disease (AD), accounting for 60-80% of cases.

• New disease-modifying therapies are available; these require pathological confirmation of abnormal amyloid pathology, usually via PET, which may not be available and/or reimbursed by insurance.

• MRI is routinely ordered for patients with dementia to “rule out” alternate pathologies but can also be used in more of a “rule in” capacity to suggest AD or other types of dementia based on patterns of atrophy.

• Reduced hippocampal volume or medial temporal lobe atrophy is the most characteristic focal finding in AD, in particular, when disproportionate to normal aging.

• Hippocampal volumetry using age-corrected norms can predict rates of progression of mild cognitive impairment (MCI) to dementia.

• Tools to generate these measurements are not in wide use, nor have these findings been validated in a clinical practice setting.
Methods

We incorporated the manufacturer-specified imaging sequences into our MRI Dementia protocol.

MRI was interpreted by 1 of 6 fellowship trained / CAQ certified Neuroradiologists without access to any post-processed volumetric data.

Several months later, the radiologists were given the volumetric data, re-reviewed the MRI exam in retrospect, and filled out a questionnaire to assess the impact of this additional data.

4 participating Neurologists were also asked to review the MRI images and volumetric data and answer questions assessing the impact of the data on their clinical diagnosis and management.

Volumetric software used:

- NeuroQuant Dementia
- Icobrain dm
- Cortechs.ai
- Icometrix
### Results

<table>
<thead>
<tr>
<th></th>
<th>Neuroquant</th>
<th>Radiologists</th>
<th>Icometrix</th>
<th>Radiologists</th>
<th>Neuroquant</th>
<th>Neurologists</th>
<th>Icometrix</th>
<th>Neurologists</th>
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<tbody>
<tr>
<td><strong>Number of responses</strong></td>
<td>59</td>
<td>54</td>
<td>41</td>
<td>32</td>
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<td>interpretation of the</td>
<td>Yes, 11/59, 19%,</td>
<td>Atrophy, especially</td>
<td>Yes, 9/54, 20%,</td>
<td>Atrophy, especially</td>
<td>Yes, 12/41, 29%,</td>
<td>Atrophy, especially</td>
<td>Yes, 7/32, 22%,</td>
<td>Atrophy, especially</td>
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<td>hippocampal atrophy</td>
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<td>diagnosis of the neurodegenerative</td>
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<td>AD considered more or</td>
<td>Yes, 6/54, 11%,</td>
<td>AD considered more or</td>
<td>Yes, 11/41, 27%,</td>
<td>AD considered more or</td>
<td>Yes, 11/32, 34%,</td>
<td>AD considered more or</td>
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<td>AD felt to be less likely</td>
<td>Yes, 1/54, 0.02%,</td>
<td>AD felt to be less likely</td>
<td>Yes, 15/41, 37%,</td>
<td>AD felt to be less likely</td>
<td>Yes, 12/32, 38%,</td>
<td>AD felt to be less likely</td>
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<td><strong>Does Neuroquantification data</strong></td>
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<td>1/41, 2%, less confidence,</td>
<td>1/32, 3%, less confidence,</td>
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<td>0/32, 0%, no influence,</td>
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<td>30/54, 56%, no change,</td>
<td>16/41, 39%, no change,</td>
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<td>9/41, 22%, strong influence</td>
<td>5/32, 16%, strong influence</td>
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<td>24/41, 59%, more confidence</td>
<td>22/32, 69%, more confidence</td>
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<td><strong>How would you rate the</strong></td>
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<td>4/41, 10%, no influence,</td>
<td>Yes, 11/41, 27%</td>
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<td>4/54, 7%, strong influence</td>
<td>9/41, 22%, strong influence</td>
<td>9/41, 17%, strong influence</td>
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</table>
**Results (cont.)**

Ratings of influence of the QR on interpretation of conventional sequences:

Neuroradiologists

- Cortechs.ai
  - No influence: 31%
  - Strong influence: 47%

- Icometrix
  - No influence: 14%
  - Strong influence: 48%

Ratings of influence of the QR on clinical interpretation:

Neurologists

- Cortechs.ai
  - No influence: 29%
  - Strong influence: 25%

- Icometrix
  - No influence: 34%
  - Strong influence: 35%

- Neuroradiologists felt more comfortable with the conventional images and were less influenced by the data presentation, given known limitations of volumetric data analysis, as well as lack of proven clinical and technical validation.

- Neurologists, however, indicated a stronger influence of the additional data on their interpretation of the imaging exam and on clinical management.
Current Algorithm for Workup of MCI/AD

1. Obtain an FDG-PET scan before LP
2. Consider LP for CSF biomarkers for AD
3. Placement on eligibility list for Lecanemab
4. Discuss participation in clinical trials

Possible alternate etiology suggested, or if LP is not consistent with AD

Obtain an FDG-PET scan before LP

Symptoms are persistent, with high suspicion for progressive decline

Consider LP for CSF biomarkers for AD

Mild AD, with confirmed AD pathology

Start AChE inhibitor
- Placement on eligibility list for Lecanemab
- Discuss participation in clinical trials

Amnestic MCI, with confirmed AD pathology

Placement on eligibility list for Lecanemab
- Discuss participation in clinical trials

MRI brain imaging
1. Exclude alternate pathologies
2. Assess patterns of atrophy by visual inspection
3. Interpret Quantitative data

H&P to rule out other medical conditions
Cognitive testing to assess for amnestic-predominant profile with supportive features
Pertinent lab work (B12, TSH, folate, RPR, etc.)

How would volumetric data factor into this workflow?
Discussion

• What weight is given to the volumetric data?
  The volumetric data is one of several possible indicators of AD, and should not be considered in isolation.

• What will we consider abnormal hippocampal atrophy? 1 SD or 2 SD?
  Disproportionate hippocampal atrophy 2 standard deviations below the norm would support the diagnosis of AD. Other areas of disproportionate atrophy could indicate an alternate dementia diagnosis.

• How will radiologists factor the volumetric data into our MRI interpretation?
  The conventional sequences will be reviewed and interpreted independently. The volumetric dataset will be assessed for diagnostic accuracy, noting specific patterns of atrophy, which can be confirmed by retrospective evaluation of the conventional sequences.

EXAM DESCRIPTION: MRI Brain without enhancement

TECHNIQUE: MRI Brain w/o enhancement was performed per [<Protocol>]

COMPARISON: [ ]

INDICATION: [ ]

FINDINGS:

BRAIN/EXTRAAXIAL:
[There is no restricted diffusion to indicate the presence of acute infarction.]
[There is no extra-axial collection, mass effect, or midline shift.]
[No large intracranial hemorrhage is identified.]
[The ventricles, sulci, and cisterns appear proportional and age-appropriate.]
[The major vascular flow voids are preserved.]

BONES/SOFT TISSUES: [ ]

VOLUMETRIC ANALYSIS: [Diagnostic.]

IMPRESSION: [ ]
Conclusion

• We described our approach to end user feedback-based acceptance testing and introduction of volumetric Ai software products into our practice.

• Assessment data was used to gain familiarity with the image appearance and results produced by the products as well as their resonance with the clinical providers.

• In the process we engaged in interdisciplinary dialogue, established interpretation standards, and outlined a clinical workflow, thereby allowing for a more comprehensive purchasing and implementation decision.

• The choice of the preferred solution for permanent production implementation was based on Radiologist preference for spatial resolution in the manufacturer specific source data sequence and Neurologists favoring a more comprehensive data presentation by one vendor.