Redundancy in Neurovascular Imaging: Where Happened? Whose Fault?

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Purpose:
Redundant neurovascular imaging studies such as Carotid US, CTA, MRA, and DSA may add cost to healthcare in the evaluation of patients with new neurologic deficits. However, there has been an assumption that this is due to clinicians' mismanagement. We sought to determine to what extent such redundant studies are generated by radiologists' recommendations.

Materials/Methods Used:
The study was considered a quality improvement analysis and therefore did not require an IRB submission and was HIPAA compliant. The Radiology Information System was queried for the presence of carotid ultrasound, CT angiography, Digital Subtraction Angiography (DSA) and MR angiography occurring within 48 hours, 72 hours, and 7 days of each other in the setting of new neurologic symptoms during the calendar year 2016. The reports were reviewed to determine how often 1) there were redundant studies and 2) radiologists recommended the additional studies.
We excluded the study which had done for new symptoms onset, interval interventions, aneurysmal and non-aneurysmal hemorrhage, arteriovenous fistula/ malformation, vasculitis, vasospasm, trauma setting and in case that the reports were unavailable.
We evaluated consistency or discrepancy for carotid stenosis by NASCET criteria as below:
<50%, 50-70%, or > 70% by NASCET criteria
Consistent – same categories for both carotids
Discrepant – different categories for one or both

Results:
50 potentially redundant noninvasive imaging cases were noted including 37 NASCET consistent and 13 NASCET discrepant cases as table 1. Common reasons for redundancy was motion degradation artifact, unnecessary neck imaging request n case of head pathologies and conservative imaging request as a followup for traumatic patients.

Conclusions:
Redundant imaging occurred less than we expected, which may be credited to referring neurologists and protocoling radiologists. Some redundancy may be acceptable for a disease process with high
morbidity and mortality and effective interventions such as carotid endarterectomy. However, stenosis measurements mandated to clearly stated in report body and/or impression to prevent unnecessary additional imaging.

**Primary Category:**
Quality and Safety

**Secondary Category:**
Advocacy, Economics and Health Policy

**Area of Focus:**
Diagnostic Radiology

Attachments:

**Table 1. Distribution of redundancy between main neurovascular imaging modalities**

<table>
<thead>
<tr>
<th>Study 1</th>
<th>Study 2</th>
<th>Consistent</th>
<th>Discrepant</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRA</td>
<td>CTA</td>
<td>18</td>
<td>5</td>
<td>23</td>
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<td>MRA</td>
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<tr>
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<td>US</td>
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<td>2</td>
<td>6</td>
</tr>
<tr>
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<tr>
<td>US</td>
<td>MRA</td>
<td>0</td>
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<td>0</td>
</tr>
</tbody>
</table>

|              |          | 37         | 13         | 50    |
| Radiologist recommended | 12 (32%) | 3 (23%)    | 15 (30%)   |
Fig 1. Motion artifact caused redundant imaging: 82 F with left facial weakness. No acute infarct. MRA with time-of-flight only noted to be motion degraded but without stenosis. Neurology requested CTA due to motion that confirmed patent neck arteries.