The current state of MR imaging in vascular access imaging

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Overview & Aim
Failure rates remain high for AVFs [1] despite multiple studies into factors which might predict the outcome [2]. Pre-operative US imaging has been shown to increase AVF placement, but the effect on maturation is unclear [3]. US can miss problems associated with central vessels, which can be a source of significant problems for these patients. Post-operatively, US can identify reductions in flow in established VAs, indicative of failure. DSA is commonly used to diagnose problems patients may have with a VA but exposes the patients to contrast, and imaging teams to radiation. MRI offers excellent visualisation of central veins, it can depict flow dynamics, and contrast or non-contrast enhanced sequences exist. However, MRI does not seem to be commonly used in these patients. A review was conducted to determine the current state of MR imaging research in patients awaiting, or with a vascular access. Studies were compared on design, imaging parameters, statistical methods and patient status.

Search Strategy & Results
A Pubmed search was conducted using search terms: magnetic resonance*, MRI, MRA, blood vessels, fistula, anastomosis, shunt, vascular access, haemodialysis*, dialysis*, CKD, Chronic kidney*, article, meeting, clinical trial, other. Exclusion terms: brain, neuro*, ventric*, liver, animal*, case report, review and letter. The search identified 126 papers, after exclusions 19 were left for analysis. Of these, 5 involved imaging patients before VA creation and 14 after VA creation.

Table 1: Study demographics

<table>
<thead>
<tr>
<th>Patient access type</th>
<th>Postoperative (n=16)</th>
<th>Preoperative (n=5)</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVF</td>
<td>390</td>
<td>152</td>
<td>542</td>
</tr>
<tr>
<td>AVG</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NR</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Volunteers</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Awaiting access</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Studies comparing MRI with:

- DSA: 8
- US: -
- DSA & US: 2
- CT: 1
- Other MRI sequence: 1
- No comparator: 2

Field Strength (T):
1.5: 12
3: 2

Contrast use:
Yes: 11
No: 3

Search

Exclusions

126 papers

19 papers

CFD studies

Others

Phantom studies

Other AVFs

5 pre-operative

14 post-operative

No RCTs were identified in the search. The most common endpoint was stenosis detection. 8 studies included some kind of image quality analysis. Discrepancy seen in stat. usage.

16 studies used some form of contrast agent. An upward trend could be seen in GBCA usage and study frequency until association with NSF. Iron based contrast and NCE-sequences can be seen emerging in recent years.

Unanswered: Has NSF curtailed MRI research in NSF patients? Can MRI reduce failure rates? Will the trend of Fe-contrast or NCE-MRI studies pick up?

References


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