Technical Aspects on MRI Evaluation of Stent Grafts for Abdominal Aortic Aneurysms

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INTRODUCTION
MRI/MRA provides the relevant information needed for follow-up of endoluminally treated abdominal aortic aneurysms (1). The aim of this study was to evaluate - the metal artifacts on MRI/MRA and CT,
- safety aspects on temperature changes in stent grafts during MR scanning and
- the possible value of MR velocity mapping.

MATERIAL AND METHODS
All MR studies were performed on a 1.5 T Siemens Magnetom Vision system.

Metal artifacts of stent grafts
In vivo
Metal artifacts were judged on MRI/MRA and spiral CT in 18 patients at the body, bifurcation and limb junction of the stent graft. The degree of imaging artifacts were judged as: mild = 1, moderate = 2, and severe - not possible to evaluate = 3.

In vitro
A nitinol polyester stent graft (VanguardTM) was placed in a phantom containing saline solution (NaCl 9 g/l, MnCl₂ 0.13 mmol/l). The maximum metal artifacts were measured at the graft body and graft limb junction on MRI/MRA and on CT.

Temperature changes in stent grafts during MR scanning
Temperature was monitored during MR scans by use of four single sensor fluoroptic probes (Luxtron, model 3000). Three probes were attached to the stent graft (body, limb junction and limb) and one probe was placed in the surrounding saline solution.

Velocity Mapping
Velocity mapping was performed in seven male patients with abdominal aortic aneurysm before, and one and six months after endoluminal stent graft placement.

Temperature changes in stent grafts during MR scanning
No temperature increase was detected at the sites of the fluoroptic probes.

Velocity mapping
In the volunteer group, flow values obtained in this study were in agreement with previously published values (2). No major differences in flow values were observed between the MR examination before and after endoluminal graft placement. As an example, in the left femoral artery we obtained (AV ± 1 Sd) 236 ± 86 ml/min before and 237 ± 139 ml/min one month after endoluminal stent graft placement.

CONCLUSIONS
- Metal artifacts of stent grafts are minimal on MRI/ MRA. On CT they are minimal at the graft body but severe at the graft bifurcation and graft limb junction (Figs 1 and 2).
- Nitinol-polyester stent grafts (Miahle StentorTM, MinTEC, Bahamas; and VanguardTM, Boston Scientific, Oakland, NJ) are thermally safe for MR scanning.
- Velocity mapping did not provide any additional information in routine examinations of stent grafts. However, in certain situations this may be of value.

REFERENCES

Table 1. Metal artifacts in vivo (1=mild, 2=moderate, 3=severe); No. of patients

<table>
<thead>
<tr>
<th>Grade</th>
<th>Graft body</th>
<th>MR Graft bifurc.</th>
<th>Graft limb junction</th>
<th>CT Graft body</th>
<th>CT Graft bifurc.</th>
<th>CT Graft limb junction</th>
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Table 2. Metal artifacts in vitro (mm)

<table>
<thead>
<tr>
<th></th>
<th>Graft body</th>
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<tbody>
<tr>
<td>MR</td>
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<td>3-4</td>
</tr>
<tr>
<td>CT</td>
<td>1-2</td>
<td>&gt; 50 &quot;beam hardening&quot;</td>
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Metal artifacts of graft limb junction on 3D-MRA (Fig. 1) and CT (Fig. 2) in vitro