MR and CT venography for imaging venous obstruction

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Disclosure

Speaker name:

.......Hendrik von Tengg-Kobligk........................................

I have the following potential conflicts of interest to report:

☐ Consulting

☐ Employment in industry

☐ Stockholder of a healthcare company

☐ Owner of a healthcare company

☐ Other(s)

☒ I do not have any potential conflict of interest
Proximal venous outflow obstruction (PVOO)

- Increasingly recognized
- Lower extremity findings:
  - varicose veins
  - deep vein thrombosis
  - edema, ulceration
  - postphlebitic syndrome, and
  - venous reflux

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Proximal venous outflow obstruction (PVOO)

- **Post-thrombotic**
  - Segmental with wall fibrosis and trabeculations

- **Non-thrombotic iliac vein lesions (NIVL’s)**
  - Subsegmental
  - May-Thurner Syndrom etc.

- **Mixed lesions**
Open Question

- Which imaging modality is key?
Imaging: venography options

Guideline 4. Imaging studies

<table>
<thead>
<tr>
<th>Guideline No.</th>
<th>4. Imaging studies</th>
<th>GRADE of recommendation</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>We recommend that in patients with varicose veins and more advanced chronic venous disease, computed tomography venography, magnetic resonance venography, ascending and descending contrast venography, and intravascular ultrasonography are used selectively for indications, including but not limited to post-thrombotic syndrome, thrombotic or nonthrombotic iliac vein obstruction (May-Thurner syndrome), pelvic congestion syndrome, nutcracker syndrome, vascular malformations, venous trauma, tumors, and planned open or endovascular venous interventions.</td>
<td>1</td>
<td>A. High quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Weak</td>
<td>B. Moderate quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B. Moderate quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C. Low or very low quality</td>
</tr>
</tbody>
</table>
CE-MR venography protocol (Bern)

• Standard clinical 3 Tesla MR System
1. T2-weighted morphological imaging (ax, cor)
2. Gd-based i.v. contrast agent with prolonged intravascular half-life
3. MR angiography (cor): 3 phases, ~20s each, 1mm sl. thickness
4. Steady state (cor): approx. 5 min., 0.8mm sl. thickness

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Case #1

- 39 yo female with chronic pelvic pain
First pass 3D ANGIO ARTERIAL
3D ANGIO, VENOUS PHASE, MPR

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Axial T1w GRE, fat sat
3D T1w GRE, fat sat, STEADY STATE
EMBOLIZATION AND STENTING

Performed by Prof. Nils Kucher, Inselspital, Bern
EMBOLIZATION AND STENTING

Performed by Prof. Nils Kucher, Inselspital, Bern
53-yo w, chronic abd pain, weight loss.

MDCT venography

R. Lamba et al, 2014
GASTROINTESTINAL IMAGING
Case #2

• 23 yo male with post thrombotic syndrome
3D ANGIO ARTERIAL

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T1w GRE FS, axial

IVC OCCLUSION

ASCENDING LUMBAR VEINS

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RECANALIZATION AND STENTING

Performed by Prof. Nils Kucher, Inselspital, Bern
Case #3

• 55 yo male with retroperitoneal tumour
3D ANGIO ARTERIAL

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Axial GRE T1w, FS

IVC OCLUSION FROM TUMOUR

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Coronal T1w, GRE, FS

PARTIAL ILIAC OCCLUSION

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ANGIOGRAM AND STENTING

Performed by Prof. Nils Kucher, Inselspital, Bern
## Imaging Options

<table>
<thead>
<tr>
<th>Modality</th>
<th>Gold SD</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Bern</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSV</td>
<td>x</td>
<td>High spatial &amp; temporal resol.</td>
<td>Radiation, luminography, underfilling, intervention, CM</td>
<td>x</td>
</tr>
<tr>
<td><strong>CTV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <em>direct</em></td>
<td>High venous CNR, no art. overlay; surrounding struct.</td>
<td>Radiation, underfilling, peripheral venous access, CM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <em>indirect</em></td>
<td>Fast, easy</td>
<td>Radiation, limited venous CNR, art. overlay, CM</td>
<td>(x)</td>
<td></td>
</tr>
<tr>
<td>CE-MRV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <em>direct</em></td>
<td>No radiation, high venous CNR, no art. overlay, surrounding struct.</td>
<td>Advanced protocol, long acquisition, peripheral venous access, underfilling, CM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- <em>indirect</em></td>
<td>No radiation, high spatial resolution in steady-state</td>
<td>Advanced protocol, long acquisition, art. overlay, CM</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>NCE-MRV</td>
<td></td>
<td>No CM</td>
<td>Flow artefacts, small imaging volume</td>
<td></td>
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<tr>
<td>IVUS</td>
<td>x</td>
<td>No CM, high spatial resol.</td>
<td>Limited surrounding tissue; intervention</td>
<td>x</td>
</tr>
</tbody>
</table>

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### CT vs. MR venography

#### Image findings in CVD and ability of CTV and MRV to visualize them

<table>
<thead>
<tr>
<th>Image finding</th>
<th>CTV</th>
<th>MRV</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stenosis</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Occlusion</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Atresia</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Collaterals</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Webs/spurs/trabeculations</td>
<td>O</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Veinwall thickening</td>
<td>O</td>
<td>X</td>
<td>With CT in-stent intimal hyperplasia can be seen</td>
</tr>
<tr>
<td>Oedema</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

- X, can visualize; O, cannot visualize
- CVD, chronic venous disease; CTV, computed tomographic venography; MRV, magnetic resonance venography

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**References**

Arnoldussen CW et al, Phlebology 2013
Arnoldussen CW et al. Phlebology 2015
Conclusion

• **MR and CT venography** provide detailed 3D anatomy for planning of intervention and complication management.

• **IVUS / DSV** still diagnostic **gold standard**

• **Post-therapy control**: consider ionizing radiation and device related imaging artefacts with care to evaluate long term efficacy.
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