The role of CT and MRI imaging for planning venous procedures

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Disclosure

Speaker name:
Nils Kucher: no conflict of interest for this presentation

I have the following potential conflicts of interest to report:

X Consulting BTG, Boston, Optimed, BARD

☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☐ I do not have any potential conflict of interest
Topics

• CT Venography; MR Venography

• Indications of CTV and MRV
• Advantages of CTV and MRV
• Type and techniques
• Duplex
• Examples
Indications for CTV/ MRV prior to intervention

• PTS involving IVC or iliofemoral veins
• Pelvic congestion syndrome, varicocele, or nutcracker syndrome
• Non-thrombotic compression of IVC or iliac veins
• Congenital venous abnormalities
• Vascular malformations
• Acute iliofemoral DVT only in exceptional cases
Imaging findings to suggest acute DVT

• Swollen vein - larger than contralateral side
• Low attenuation center
• Few collaterals
• Stranding of the perivenous soft tissue – suggestive of oedema
• High attenuation rim, due to contrast in the vasa vasorum and vessel wall inflammation
Do we need CTV or MRV for acute DVT prior to intervention?

- In most patients with acute iliofemoral DVT, cross-sectional imaging is not needed prior to intervention.
- Scenarios where imaging is helpful:
  - Cancer-associated DVT
  - Bilateral DVT involving IVC (atresia?)
  - Lymphocele (no stents)
  - Mechanisms of venous pathology other than anatomical compression
Duplex is key for acute iliofemoral DVT and PTS prior to intervention

• Only reliable imaging modality for differentiating ascending from descending iliofemoral DVT (popliteal vein patent?)
• Indirect CTV does not show distal thrombus extent
• Only reliable imaging modality for identifying important leg inflow veins
• Only reliable imaging modality with hemodynamic information
Massive DVT of IVC and bilateral iliofemoral veins
DVT ≠ DVT
Mixing up different diseases in RCTs

Ascending femoropopliteal DVT

Descending iliofemoral DVT

Inflow unlikely to be improved by CDT

Inflow almost always improved by CDT & stent
Imaging findings suggesting Chronic DVT

- Small vein compared to contralateral side
- Multiple deep or superficial collateral veins
- Direct visualisation of a thrombus with irregular margins
- Partial DVT recanalisation may result in heterogenous lumen and endoluminal stranding
- Endoluminal calcification
- Eccentrically located thrombus, adherent to the vein wall
- Normal perivenous fat, no stranding
- Thick walled, poorly enhancing, retracted veins
<table>
<thead>
<tr>
<th></th>
<th>CTV</th>
<th>MRV</th>
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</thead>
<tbody>
<tr>
<td>Time</td>
<td>2 mins</td>
<td>30 mins</td>
</tr>
<tr>
<td>Radiation dose</td>
<td>7-12 mSv</td>
<td>zero</td>
</tr>
<tr>
<td>Contrast</td>
<td>Always, iodinated</td>
<td>Preferred, Gadolinium</td>
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<tr>
<td>Renal failure</td>
<td>Depends on eGFR</td>
<td>NSF 0.2%</td>
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<td>General applicability from a technical point of view</td>
<td>Easy</td>
<td>More challenging</td>
</tr>
<tr>
<td>Post stenting</td>
<td>Can see thrombus + flow</td>
<td>Significant signal drop-out</td>
</tr>
<tr>
<td>Ability to combine with Pulmonary Art imaging</td>
<td>CTPA +CTV easy</td>
<td>MR PE protocol not recommended from guidelines</td>
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Advantages of CTV over MRV

- Readily available in most institutions even in acute patients
- Can be used in patients with claustrophobia
- Technically easy to perform
- Short acquisition time
- Cheaper
- Good image quality in the majority of patients
- Less artifacts in patients with increased bowel movements
- Better image quality of suprarenal IVC (single breath-hold image acquisition)
- Less often underestimation of PTS severity
- Can be used in patients with joint implants, pacemakers defibrillators (less artifacts then MRV)
- Can be used in patients with venous stents and IVC filters (less artifacts then MRV)
- Can be combined with PE protocol (not necessary in most cases)
CT venography in an obese patient after reconstruction of IVC and relapse of symptoms
Advantages of MRV over CTV

• No radiation
• Contrast free techniques available to image deep veins
• Good quality images
  • If dedicated MR protocols are used
  • If experienced MR radiologists are involved
  • If patient compliance is good
• Better image quality of leg veins and paravascular tissue
• Better image quality of collateral veins
• Better image quality of intravascular changes in PTS patients
• Better image quality to differentiate vein atresia from agenesis
MR venography of a patient with severe post-thrombotic syndrome and extended disease involving the common femoral vein
Flow-Dependent MRV

- Long acquisition times and flow artifacts
  - Gradient-recalled echo (GRE)
  - Time-of-flight MRV
Flow-Independent MRV

- Short acquisition time and less artifacts
- Balanced steady-state free precession MRV
Gadolinium-enhanced MRV

• Short acquisition time
• Better vascular information compared to flow dependent techniques
• Risk of nephrogenic systemic fibrosis (NSF) 0.02%
• Should not be used in patients with severe renal dysfunction
Cross-sectional imaging for May Thurner and atypical iliac vein compression

- CTV and MRV are sensitive but not specific for the diagnosis of May Thurner
- Both false positive false negatives
- Webs and spurs may be missed
- A distance >5 mm between right common iliac artery and spine does not rule out May Thurner
Cross-sectional imaging for May Thurner and atypical iliac vein compression

Duplex May Thurner region:
Cross-sectional imaging for May Thurner and atypical iliac vein compression
What does CTPA add to CTV:

- In patients with symptomatic ilio-femoral DVT the percentage of patients with a pulmonary embolus is 67%
- Guidelines do not suggest combination of CTV with CTPA routinely
- We only use the combination if both DVT and PE are clinically severe
Direct vs Indirect CTV

- Direct means cannulation of a vessel on the side of the pathology e.g. dorsal vein foot, popliteal etc.
  - Invasive but provides detailed anatomy
  - Sometimes deep veins get lost in a blizzard of superficial information
- Indirect - peripheral IV injection
  - Quicker, easier to standardise, less “impressive” images - they don’t look like CT Angiograms one is familiar with for EVAR etc.
Direct CTV

• Needles in both feet- catheterised in the CT scanner
• Either 2 pumps or two hand injections
• Becomes more difficult with swollen limbs

• All following direct CTV images courtesy of Dr. Jean Marc Pernes, Paris, France
Conclusion

- Both CTV and MRV can be used in the majority of patients with deep venous disease prior to intervention
- Best indication is PTS involving IVC or iliac veins
  - To image extent of venous involvement
  - To diagnose mechanism of disease (compression points, atresia, cancer, etc.)
- Both techniques have advantages and disadvantages
- Use of MRV may increase if better availability and protocols
- Direct CTV not really necessary but may be used for selected cases (e.g., lower extremity PTS or vascular malformations)
The role of CT and MRI imaging for planning venous procedures

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