The role of CT and MRI imaging for planning venous procedures

Nils Kucher

USZ Universitäts Spital Zürich

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

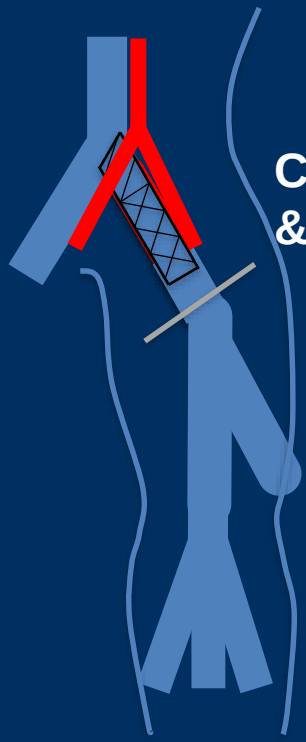
DVT ≠ DVT

Mixing up different diseases in RCTs

Ascending femoropopliteal DVT

Inflow unlikely to be improved by CDT

Descending iliofemoral DVT



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

	CTV	MRV
Time	2 mins	30 mins
Radiation dose	7-12 mSv	zero
Contrast	Always, iodinated	Preferred, Gadolinium
Renal failure	Depends on eGFR	NSF 0.2%
General applicability from a technical point of view	Easy	More challenging
Post stenting	Can see thrombus + flow	Significant signal drop-out
Ability to combine with Pulmonary Art imaging	CTPA +CTV easy	MR PE protocol not recommended from guidelines

Advantages of CTV over MRV

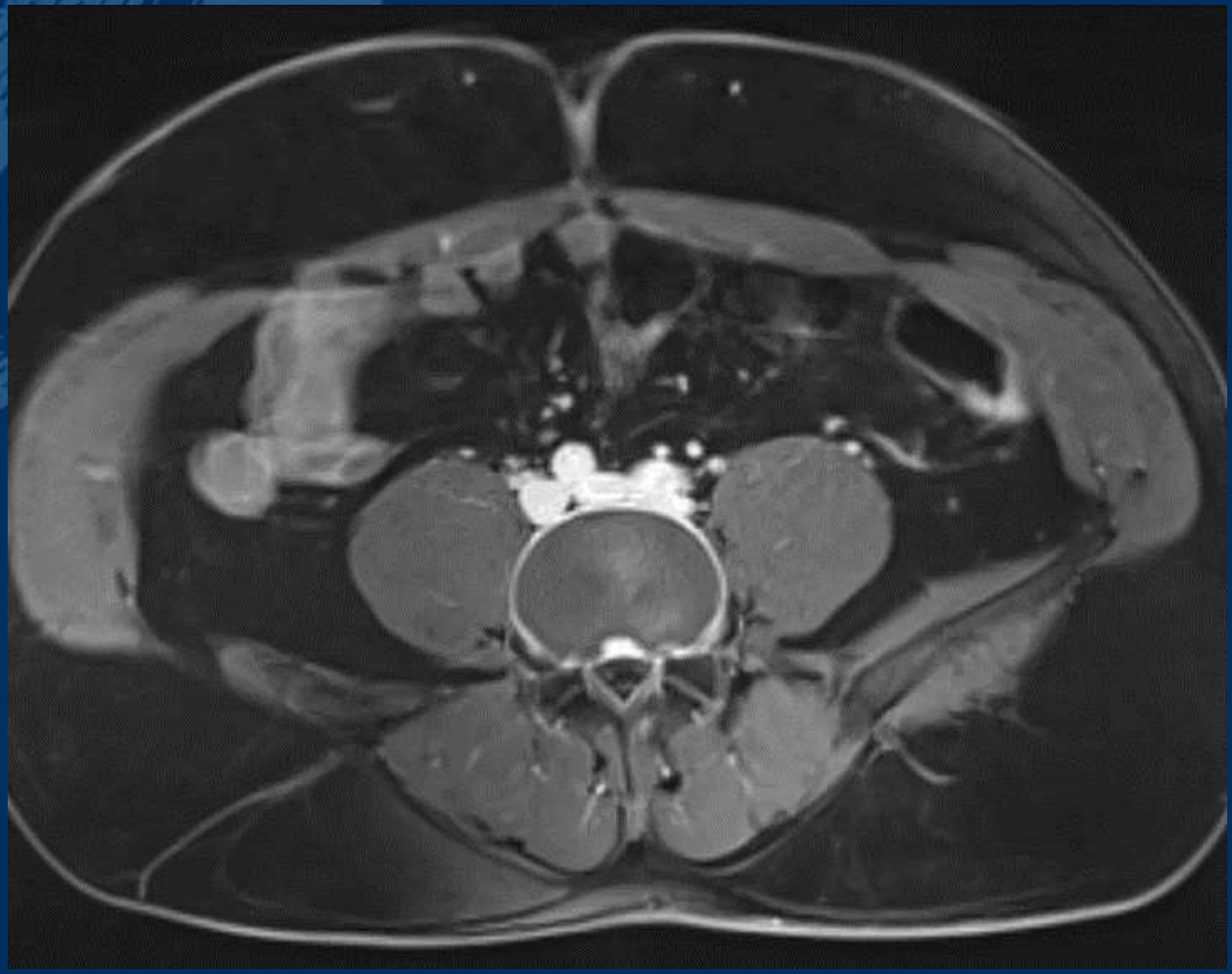
- Readily available in most institutions even in acute patients
- Can be used in patients with claustrophobia
- Technically easy to perform
- Short acquisition time
- Cheaper
- Good image quality in the majority of patients
- Less artifacts in patients with increased bowle movements
- Better image quality 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 protocoll (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

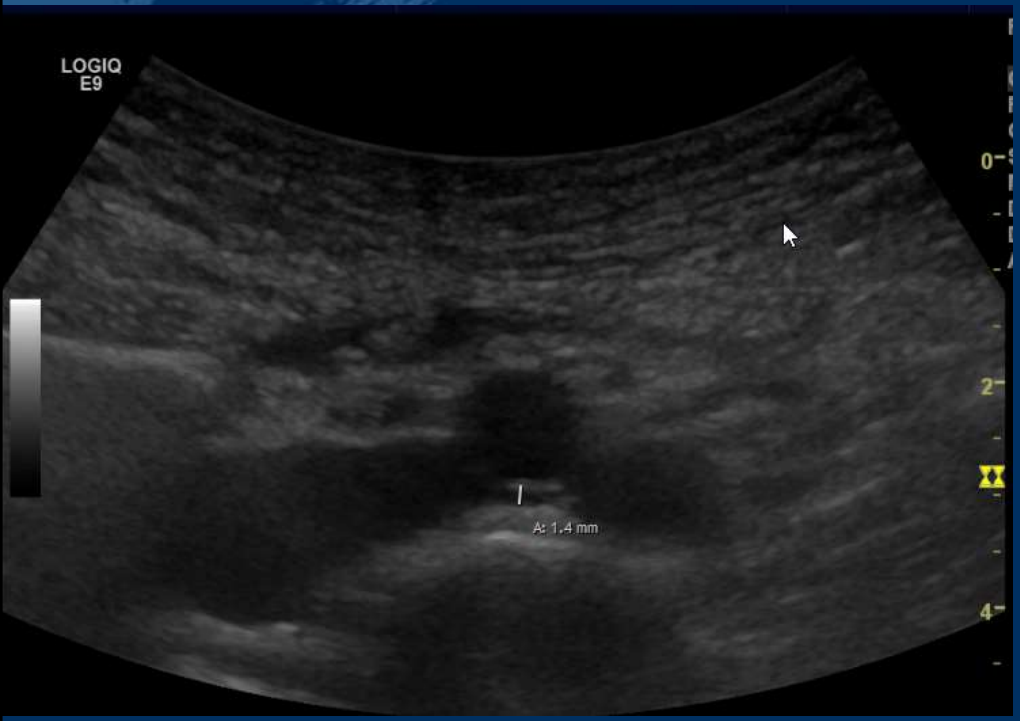
- Short acquisition time
- Better vascular information compared to flow dependent techniques
- Risk of nephrogenic systemic fibrosis (NSF) 0.02%
- Should not be used in patients with severe renal dysfunction

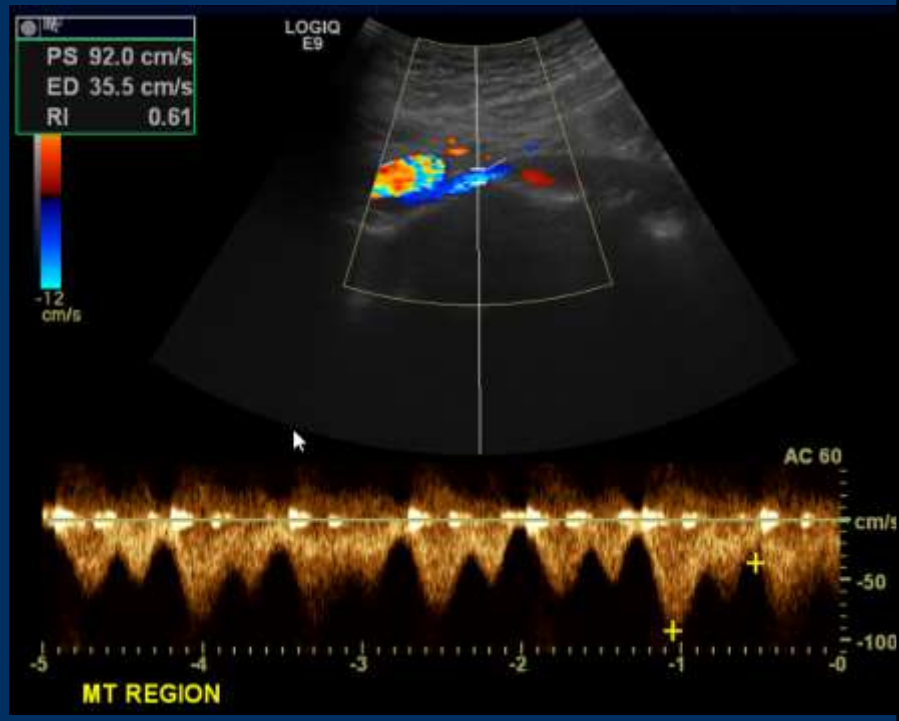
Cross-sectional imaging for May Thurner and atypical iliac vein compression

- 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

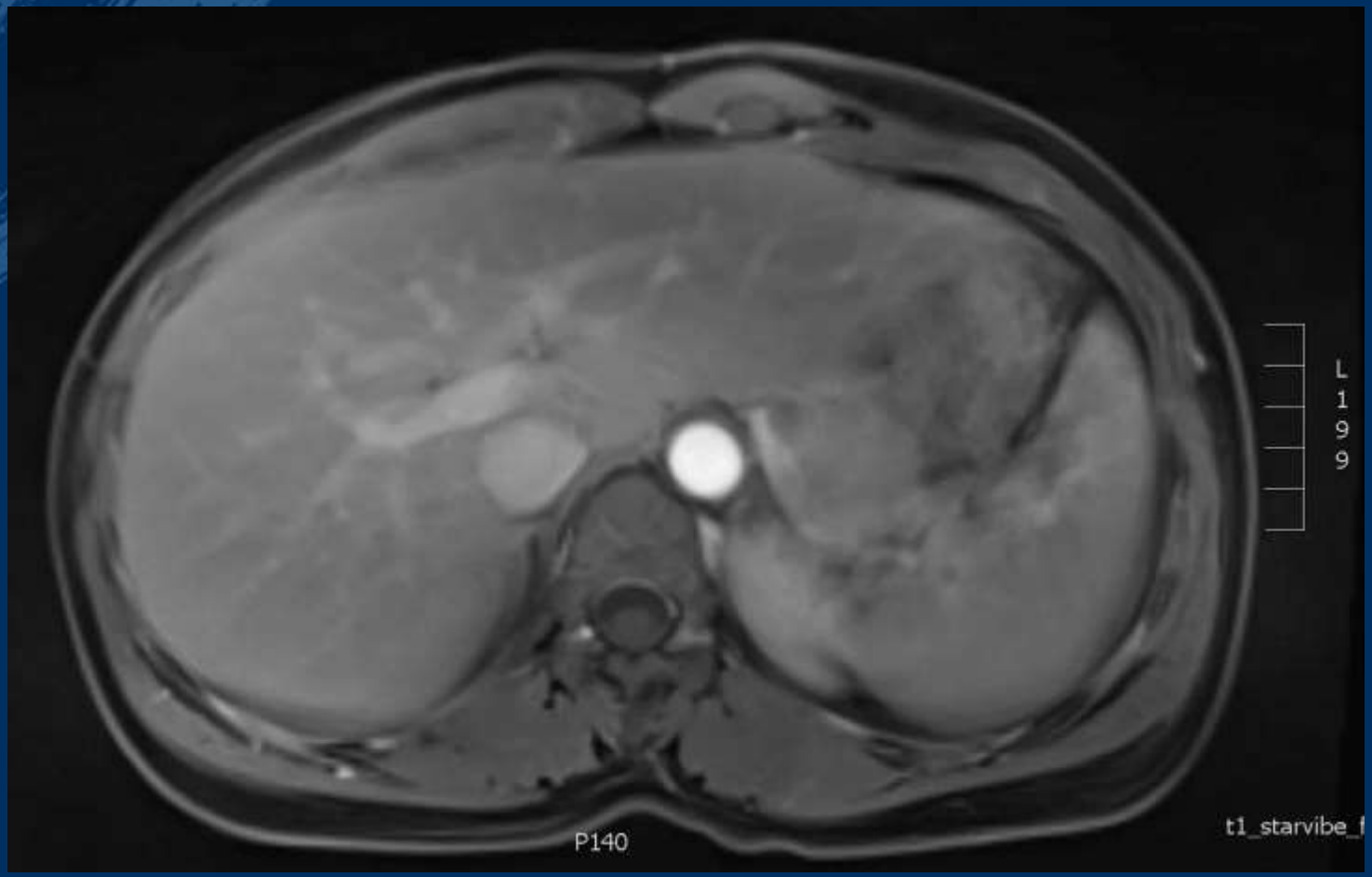
Cross-sectional imaging for May Thurner and atypical iliac vein compression

Duplex May Thurner region:





Cross-sectional imaging for May Thurner and atypical iliac vein compression



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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


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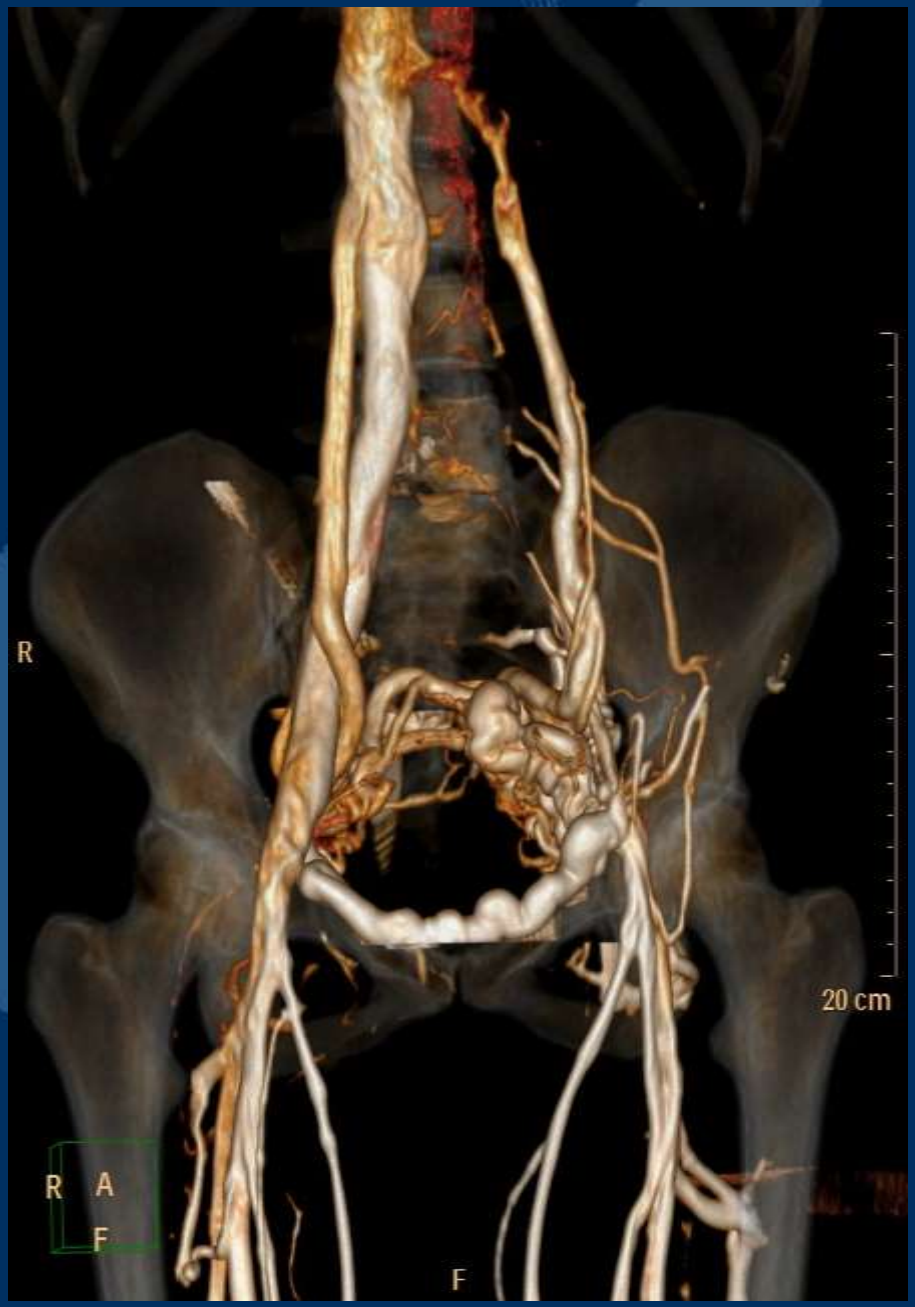
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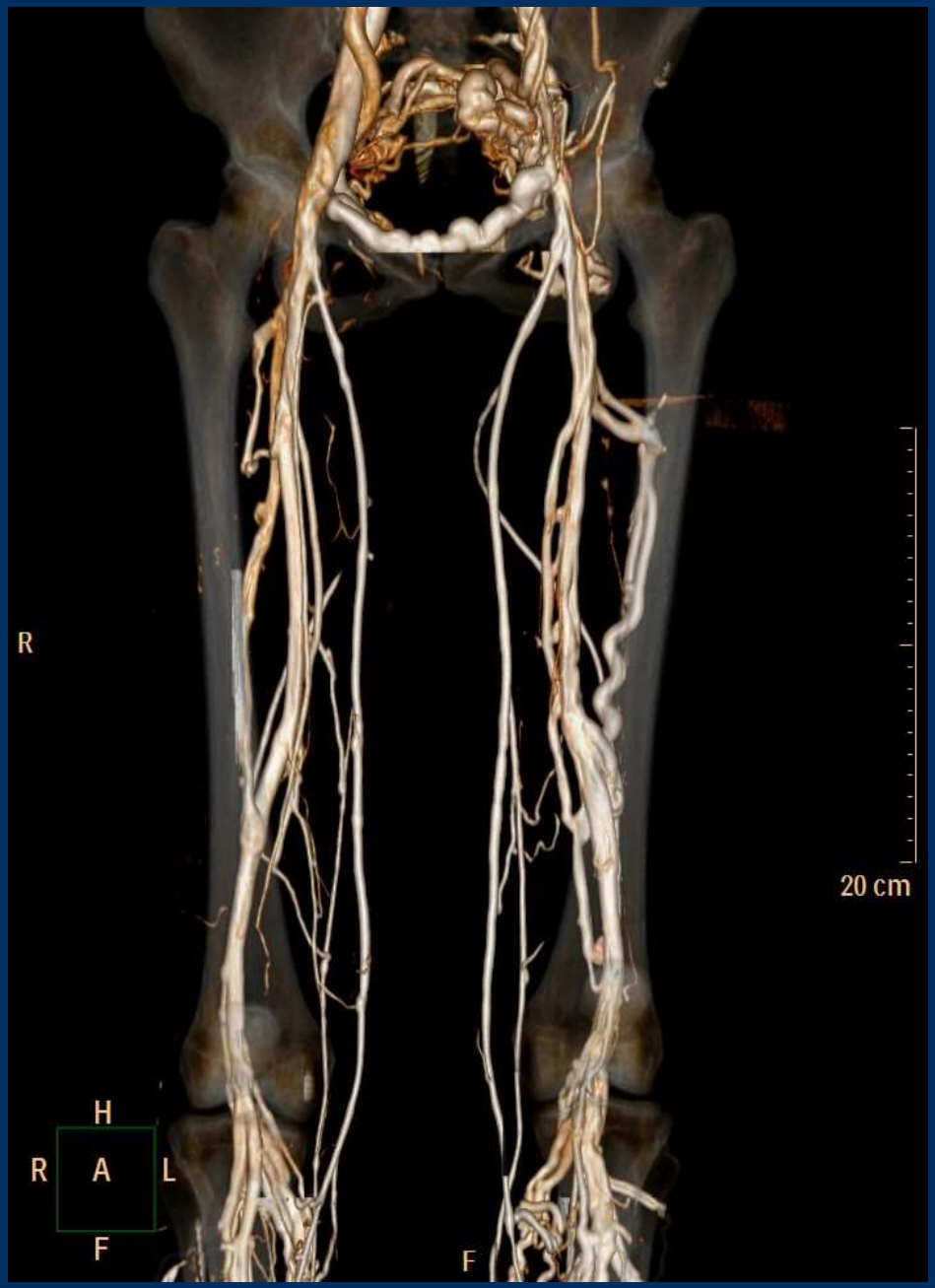
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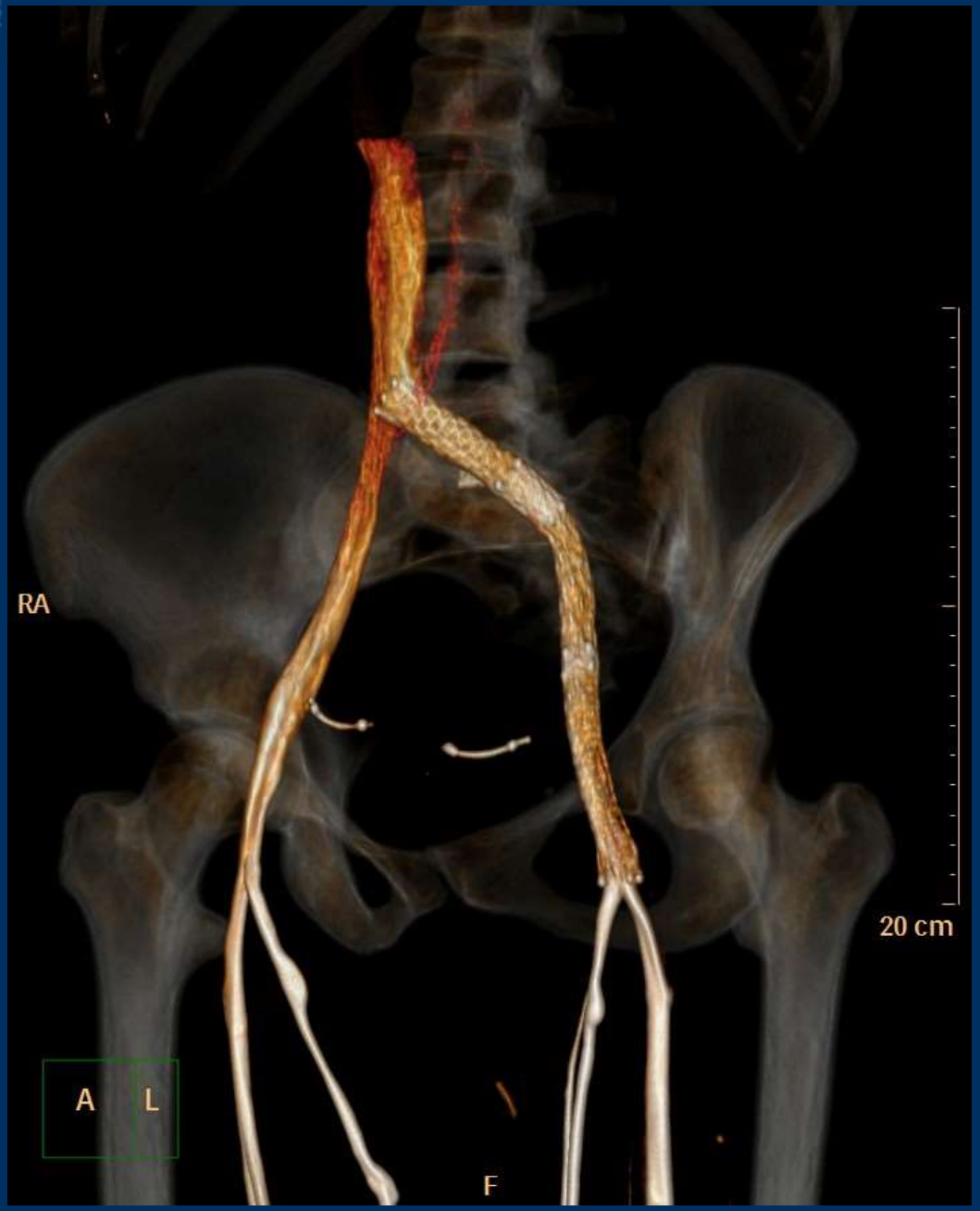
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Conclusion

- 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)

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