Optimal Imaging
During Deep Venous Interventions

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Disclosure

• The opinions and clinical experiences presented herein are for informational purposes only. Individual results may vary depending on a variety of patient-specific attributes and related factors.

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Interventional Imaging Modalities

- Standard contrast venography
- Dyna-CT
- Real-time Duplex imaging
- IVUS
IVUS in Deep Venous Interventions

- How many routinely use IVUS in deep venous interventions?
- Determination or confirmation of disease or stenosis?
- Differentiation of disease (acute v. chronic clot v. compression etc)?
- Diameter measurements?
- Because someone said it is helpful?
- Just to see what you can learn?
• 38 YO female with painful pelvic variceal syndrome who is s/p embo X 2 with recurrence.
• L renal vein compression (nutcracker syndrome)

What size stent would you use? How do you measure the diameter?
- Limited options for stent type & size
- Is the stent geometry OK
- Does it look like it is not attached to the vessel wall?
- How do we confirm?
Venography & Venous Obstruction

When do we need more information?
IVUS Image
Venogram in a 71 YO female one day s/p CDT of LLE for acute iliofem DVT

Is there iliac vein compression??
• 33 YO female with LLE edema & pain of 8 months duration
• No sig PMH
• US showed deep reflux in fem & pop veins

Do we need an IVUS for this?
IVUS Literature in Deep Venous Interventions

• Utility of IVUS evaluated in 16 pts with iliofem obstructive lesions
• Diagnostic adjunct to venography & intervention
• IVUS confirmed etiology in all 16 pts
• IVUS influenced intervention in 8/16 pts
  – Dx of acute clot in 2 pts (additional lysis)
  – Additional stents in 2 pts (correcting inflow problems)
  – Incomplete stent expansion & additional PTA in 2 pts
  – Adjustment in size of PTA balloon in 2 pts

Forauer A et al JVIR 2002;13
IVUS Literature in Deep Venous Interventions

• Compared 2 diff PMT devices in acute DVT using IVUS & venography

• IVUS more accurate than venography in:
  – determining the volume of clot lysis & presence of residual clot
  – Dx of residual dz requiring ancillary interventions

• Conclusion: “IVUS is superior to venography for detection of residual thrombus and underlying venous pathology after PMT”

Murphy EH et al. JEVT 2010;17
IVUS Literature in Deep Venous Interventions

• Literature is scant in deep venous interventions, mostly suggesting improved detection of obstructive lesions as compared to venography.
• No rigorous comparative or correlative studies with other imaging, but ....
• VIRTUS trial will provide the most comprehensive analysis of the role of IVUS & comparison to both venography & Duplex US before & after stenting and at follow up.
IVUS vs. Venogram: Diameter (Core Laboratory)

- Multiplanar Venography underestimates the degree of diameter stenosis compared to IVUS.
- Venogram missed 26% of >50% diameter-reduction lesions.
- IVUS determined stenoses, in general, were 10.9% more severe (mean) than by Venogram ($P < .001$).

Visit: https://clinicaltrials.gov/ct2/show/NCT02142062

Venogram vs. Intravascular Ultrasound (IVUS) for Diagnosing Iliac Vein Obstruction (VIDIO) case details, images, and footage courtesy of Carl Fastabend, MD. Dr. Fastabend is an investigator of VIDIO, a Philips Volcano sponsored study. Results from this case study are not predictive of future results. Data on file at Philips Volcano clinical affairs department. © 2016 Optum, Inc. All rights reserved.
IVUS vs. Venogram: Area (Core Laboratory)

- Multiplanar venography allows a relatively accurate assessment of area reduction / stenosis when compared to IVUS.
- However, 3 view venograms missed 17.7% of significant CSA lesions (defined by >50% area reduction).

https://clinicaltrials.gov/ct2/show/NCT02142062 Venogram vs. Intravascular Ultrasound (IVUS) for Diagnosing Iliac Vein Obstruction (VIDIO) case details, images, and footage courtesy of Carl Fastabend, MD. Dr. Fastabend is an investigator of VIDIO, a Philips Volcano sponsored study. Results from this case study are not predictive of future results. Data on file at Philips Volcano clinical affairs department. © 2016 Optum, Inc. All rights reserved.
Feasibility Arm of the VIRTUS Trial:

*First of its kind analysis*

- Venography under-estimated degree of stenosis by ± 12.8%
- Duplex tended to overestimate the degree of stenosis:
  - -6.9% ± 21.1% compared to venography
  - + 15.1% ± 19.0% compared to IVUS

Degree of stent over-sizing greater with venography as compared to IVUS
IVUS Advantage: Sizing of the Vessel

- Difficult to do by venography
- Has lead to mis-sizing of stents & balloons
- Oversizing may lead to stent strut erosion through the vessel wall & undersizing could increase the risk of thrombosis
Mean of the two dimensions \((15+6.2)/2 = 10.6\) mm

Based on circumference of an eclipse:

\[ P \approx 2 \pi \sqrt{a^2 + b^2}/2 \Rightarrow \text{diameter} = 11.2\ \text{mm} \]
IVUS Advantage: Presence of Acute Clot

- Residual clot after DVT lysis associated with increased risk of recurrence
  - Enden et al. Lancet 2011

- Acute clot has therapeutic solutions

- Chronic clot above the SFJ can be stented
IVUS Advantage: Determination of Extent of Disease & Precision of Stent Placement
Conclusion

- Optimal imaging depends on what information is needed
  - Distinguish acute v. chronic clot
  - Determine the accurate size of the vessel
  - Depict the length of the diseased segment
  - Pinpoint extent of pathology requiring stent placement
- Use of IVUS may change the therapeutic plan during deep venous interventions
- Does that change the patient outcome??