

The CVD Patient with Normal

Ultrasound and Venogram

I didn't know what I didn't know until IVUS

Mark J Garcia, MD, MS, FSIR, FACR

EndoVascular Consultants, LLC

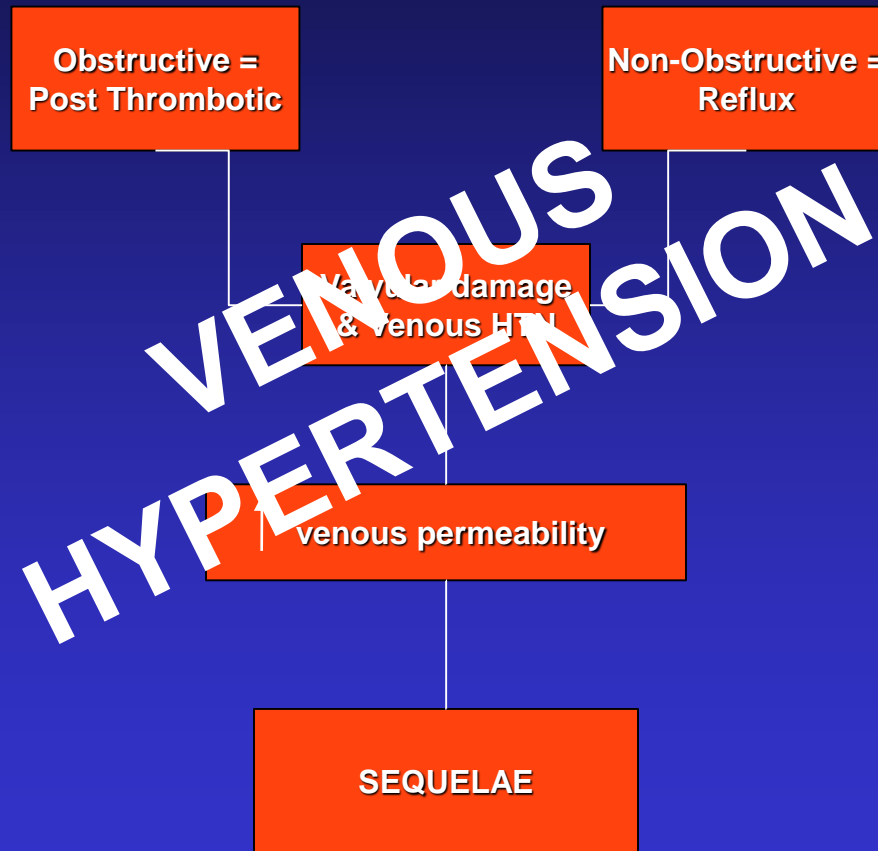
Wilmington, DE

Disclosures

- IAC Vein Centers: Board of Directors
- Merit Medical: Chief Medical Officer, Royalties
- BSX: Speaker, Research Support
- BTG/EKOS: Speaker, Research Support
- Cook Medical: Research Support
- Philips Volcano: Speaker

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Venous Disease - Pathophysiology



Key to Success: Reduce Venous HTN

- MUST Establish:
 - Inflow from calf to thigh
 - Outflow from thigh into pelvis
 - Ensure central venous patency

 - Establishing Direct In-Line Flow from ankle to heart
 - To do that you must identify what there is to treat

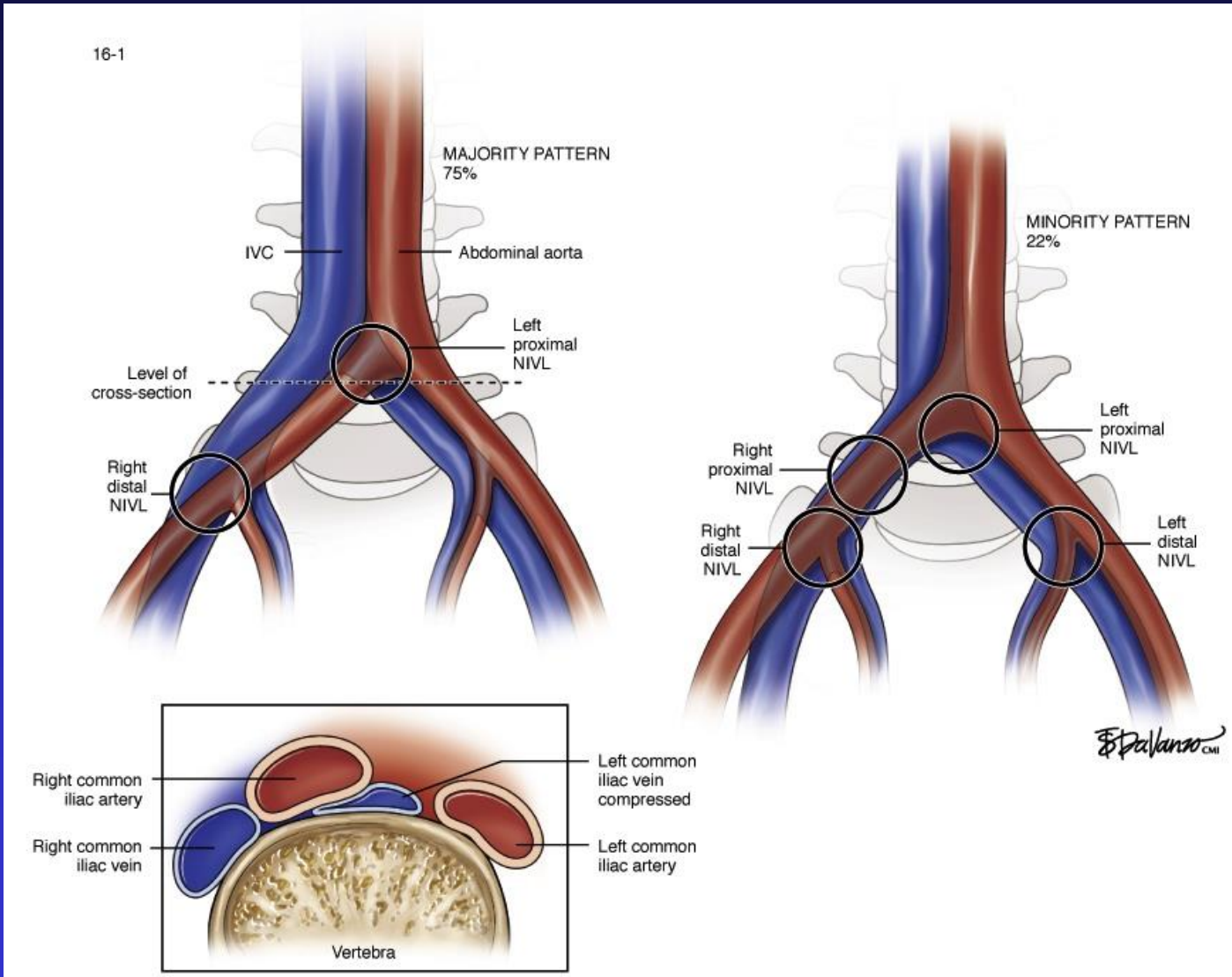
One Guarantee in an IR Practice

The more you see
The more you treat

The more likely you'll come across
something you can't explain
you'll scratch your head and admit
I don't know what the Hell to do!!!



M-T Majority & Minority Patterns



IVUS Role In IR

- In general, IR's have been more resistant to adopt IVUS despite
- Previous studies on IVUS have reported it's superiority to venography on identifying & characterizing a stenosis, however.....

this was determined using single-plane venography

- To many, the standard of care remained multi-plane venography

Until

Until....VIDIO

Venogram Versus Intravascular Ultrasound for Diagnosing and Treating Iliofemoral Vein Obstruction (VIDIO): Report From a Multicenter, Prospective Study of Iliofemoral Vein Interventions

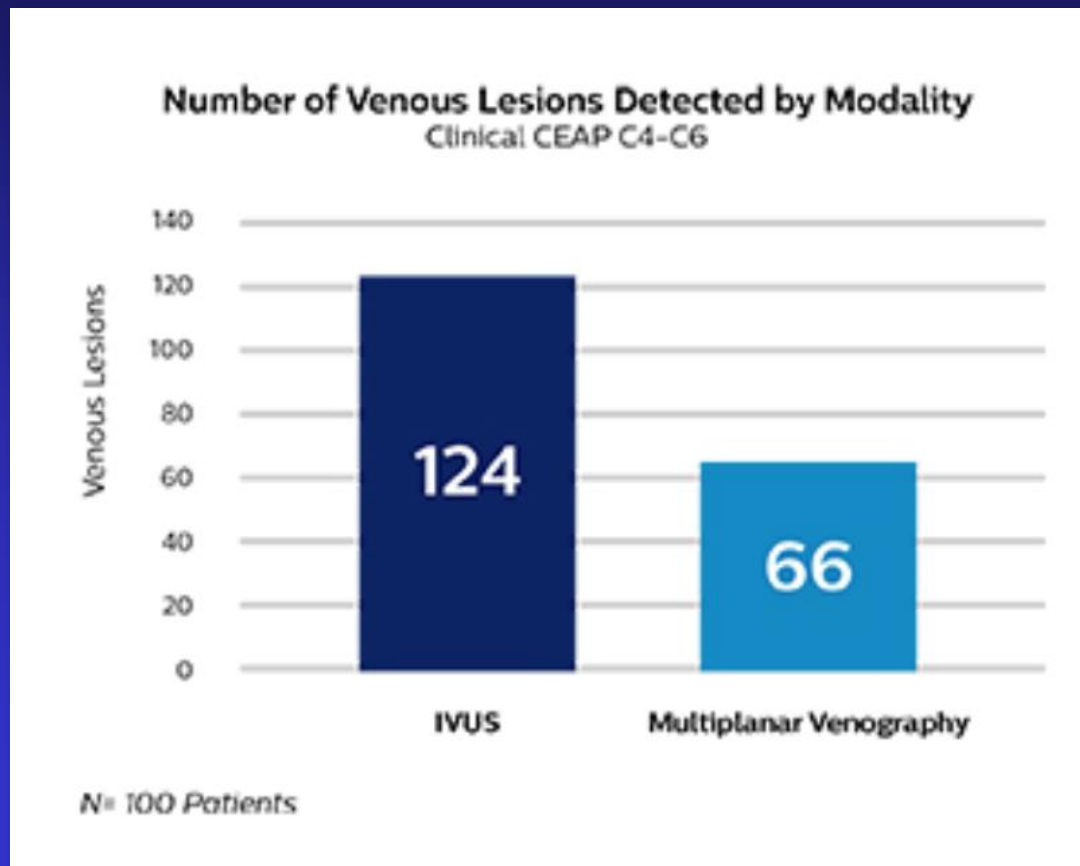
- N = 100, CEAP C4-6
- Evaluated for Iliac/CFV obstruction w/ MP venography & IVUS

Gagne, P.J. et al. Venogram Versus Intravascular Ultrasound for Diagnosing and Treating Iliofemoral Vein Obstruction (VIDIO): Abstract From a Multicenter, Prospective Study of Iliofemoral Vein Interventions. J Vasc Surg. 2016; 4(1):136.

VIDIO

- Trial to identify significant ICFVO defined as:
 - 50% diameter stenosis on venogram
 - 50% cross sectional area stenosis on IVUS
 - Identified webs or collaterals.
- Duplex ultrasound, CEAP class, Venous Clinical Severity Score (VCSS), QoL questionnaires (ie, SF 36v2, CIVIQ 14), and ulcer measurements were performed at baseline, 1 and 6 month follow up visits.

VIDIO Conclusions



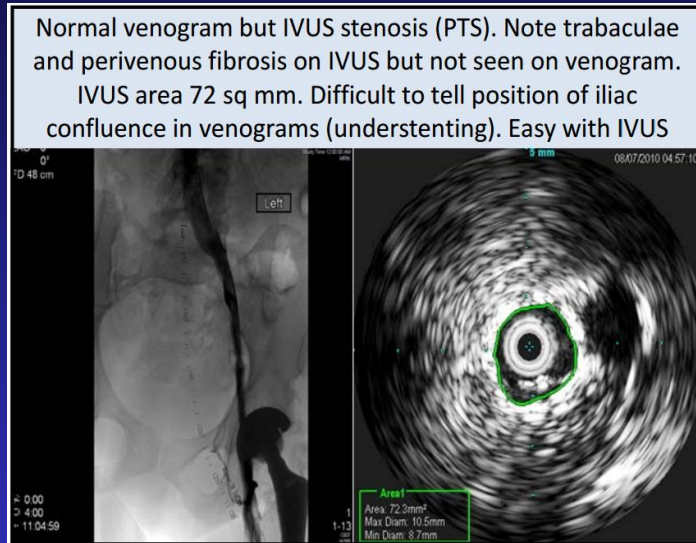
VIDIO Future Applications

- IVUS will allow for a standardization of venous lesions with less operator variability
- Will enable analysis of stenotic cohorts with reproducibility
- Cross reference cohorts with clinical severity and outcomes analysis to determine what may be.....

A Clinically Relevant Stenosis on IVUS

IVUS Clinical Value:

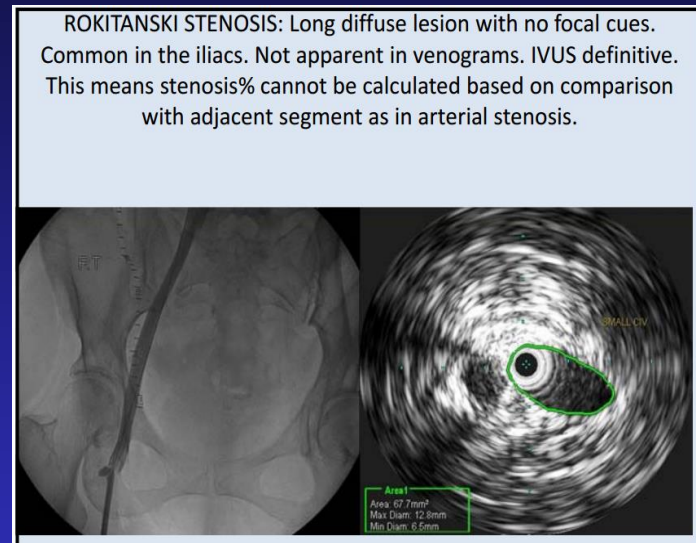
Example 1. Post-Thrombotic Syndrome



$$\sim\% \text{ Stenosis} = 1 - 72.3\text{mm}^2 / 200\text{mm}^2 = 64\%$$

Venographic % stenosis based on comparison to adjacent 'normal' segment does not work as diffuse stenosis involving the entire iliac vein (Rokitanski stenosis) with or w/o focal lesions are common.

Example 2. Rokitanski Stenosis



$$\sim\% \text{ Stenosis} = 1 - 67.7\text{mm}^2 / 200\text{mm}^2 = 66\%$$

Vein	Diameter (mm)	~Area (mm ²)
Common Iliac Vein	16	200
External Iliac Vein	14	150
Common Femoral Vein	12	125

Raju S, "How to Measure Iliac Vein Stenosis", VEITH 2014 Symposium Presentation Physician commentary is specific to the examples being highlighted. Results from this case study are not predictive of future results.

What Is The IVUS Standard?

Dr. Raju:

- CIV D = 16 mm = Area 200 mm²
- EIV D = 14 mm = Area 150 mm²
- CFV D = 12 mm = Area 125 mm²

- It's a good reference but not Gospel or set in stone
- Helpful in Rokitanski stenosis: long segment lesion without focal stenosis. Not apparent on venography

Raju et. al. J Vasc Surg Venous and Lymph Disorders. Anomalous Features of Iliac Vein Stenosis that Effect Diagnosis and Treatment. 2014;2:260-7.

Are All Veins Created Equal?

- Certainly not all humans are built equally
 - from a size standpoint
- Kibbe et al
 - Studied 50 consecutive patients in ER abdominal pain
 - Mean age 40 years, 60% female
 - Average Vein Size by location
 - Right CIV: 12.85 +/- 0.36
 - Left CIV: 12.09 +/- 0.34

Kibbe et al, Iliac Vein Compression in an asymptomatic patient population. J Vasc Surg: 39;5:937-943

IVUS To The Rescue

- 80 yo F with 34 yr hx of **BLE** swelling, pain, redness, venous eczema, < 1/2 blk venous claudication, fatigue.
- Worse w/ prolonged sitting, standing, heat
- S/P B GSV ablation for reflux
- ECS no help
- MRV suggests iliac venous compression

CEAP 4

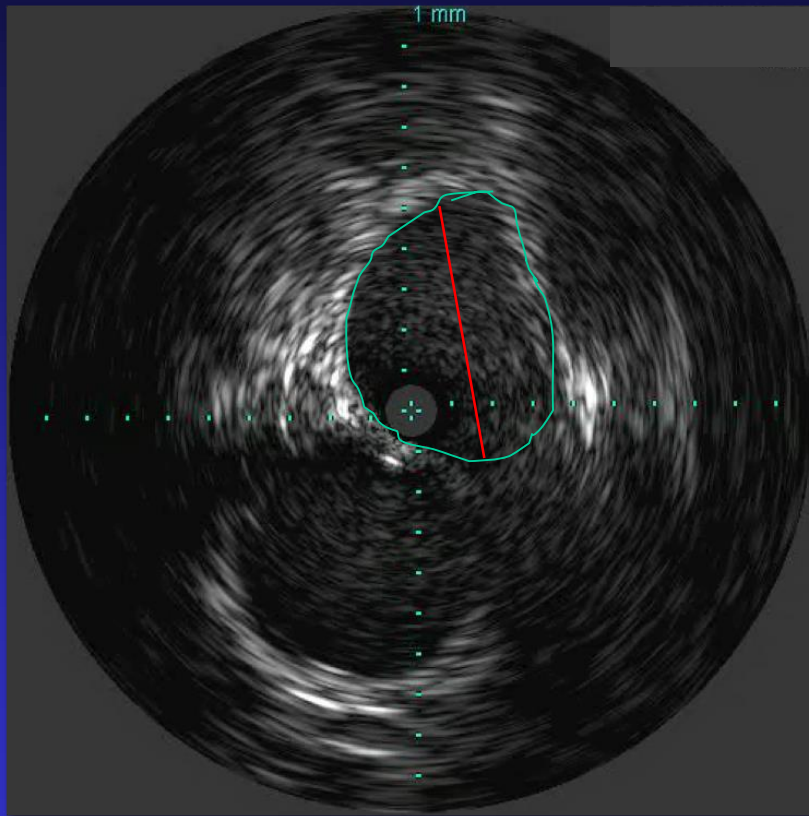


Venography: Bisk Flow

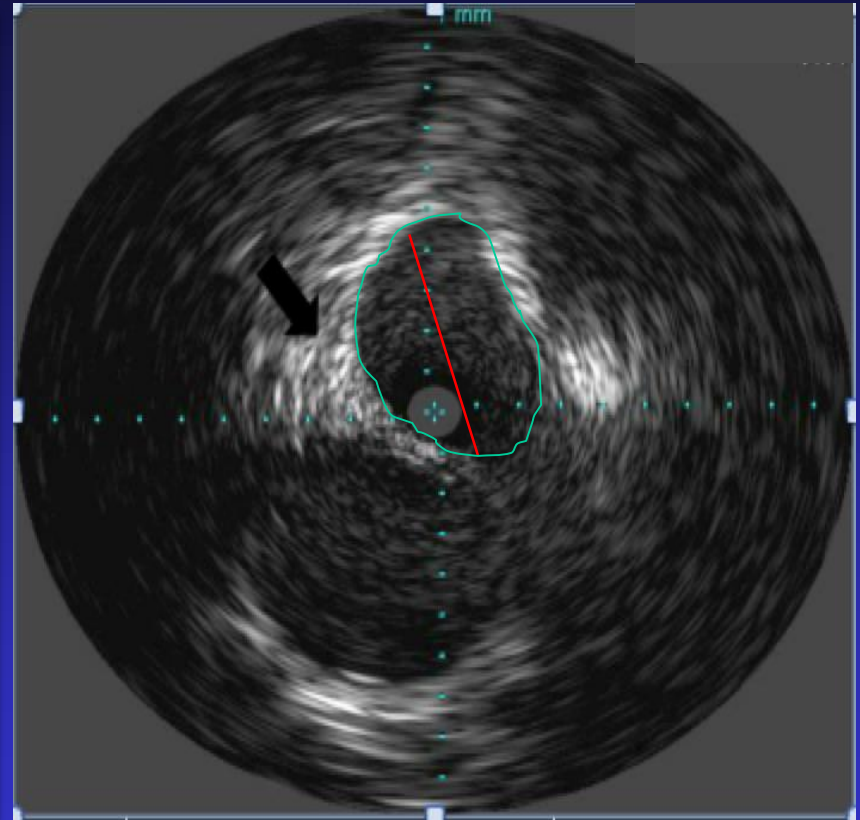


Images courtesy of Dr. Mark Garcia

IVUS



Lt CIV D=7mm A=142mm²



Lt EIV D=6.5mm A=97mm²

IVUS Findings

- Rt CIV: D=7 mm, A=112 mm²
- Rt EIV: D=4.9 mm, A=86 mm²
- Rt CFV: D=11mm, A=82 mm²
- Lt CIV: D=7 mm, A=142 mm²
- Lt EIV: D=6.5 mm, A=97 mm²
- Lt CFV: D=8.2 mm, A=94 mm²

Small Compared To What?

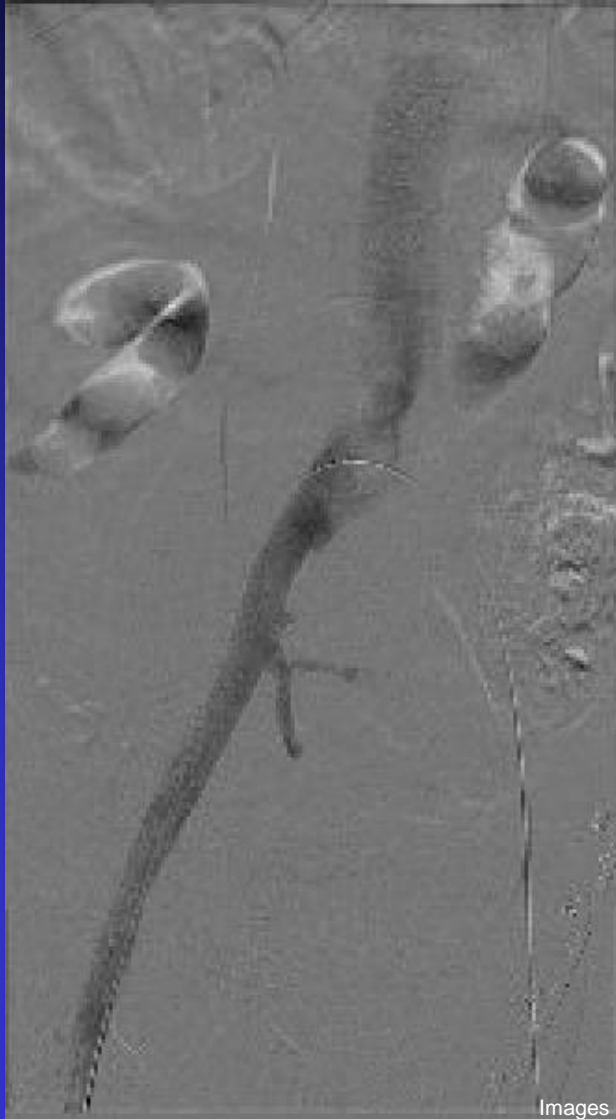
% venous stenosis calculated based on anatomic minimums

- CIV: 16 mm Diameter; 200 sq mm Area
- EIV: 14 mm Diameter; 150 sq mm Area
- CFV: 12 mm Diameter; 125 sq mm Area

Peripheral venous pressure begins to rise with as little as 20% stenosis and becomes significant at 50% stenosis.

Raju et. al. J Vasc Surg Venous and Lymph Disorders. Anomalous Features of Iliac Vein Stenosis that Effect Diagnosis and Treatment. 2014;2:260-7.

Venography



Images courtesy of Dr. Mark Garcia

F/U Post Stenting

- Post 14mm stenting bilateral CFV => Caval bifurcation

Rt CIV: D=7 mm, A=112 mm² => 159

Rt EIV: D=4.9 mm, A=86 mm² => 162

Rt CFV: D=11mm, A=82 mm² => 140

Lt CIV: D=7 mm, A=142 mm² => 161

Lt EIV: D=6.5 mm, A=97 mm² => 140

Lt CFV: D=8.2 mm, A=94 mm² => 126

- Claudication resolved w/in 24 hrs
- Near complete resolution of all signs & sx's @ 1 mo
- Persistent benefit > 2 yrs

Another Example

- 46 yo F, w/ intermittent, severe swelling **BLE** following prolonged standing, sitting & worsens w/ heat. Blisters during these episodes.
- No varicosities & no reflux
- CTV suggests possible iliac venous compression at the confluence

2nd Case: Venography



Brisk flow & no collaterals

However: IVUS Findings

But again, the clinical picture didn't correlate with the venographic findings, so..... IVUS:

- Rt CIV: D=7 mm, A=199 mm²
- Rt EIV: D=4.9 mm, A=72 mm²
- Rt CFV: D=11mm, A=176 mm²
- Lt CIV: D=7 mm, A=93 mm²
- Lt EIV: D=6.5 mm, A=80 mm²
- Lt CFV: D=8.2 mm, A=93 mm²

F/U

- Bilateral Iliofemoral stenting (14mm Protégé)
- Complete resolution of sx's @ 1mo
- Marked improvement in QOL
- Persistent improvement > 1.5 yr

Need for Clinical Correlation

- The significance of a stenosis by venography or IVUS is best determined by the presence of corresponding clinical signs and symptoms

Summary

- If It Doesn't Make Sense..... (venography, MRV, CTV)
- Don't stop there: Investigate further (IVUS)
- IVUS can be very helpful in diagnosing situations that otherwise might go undetected
- Important to correlate the clinical signs & Sx's with all imaging to determine course of action

Thank You