University of Nebraska Medical Center

Management of Venous Thromboembolism

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Disclosures

None

What is Venous Thromboembolism (VTE)

Definition: A condition in which a blood clot forms in a vein and may travel to the lungs leading to a pulmonary embolism:

Includes:

- Deep vein thrombosis (DVT): Clot forms in the deep vein, commonly in the legs

- Pulmonary embolism: Clot that travels to the lungs (pulmonary artery tree)

Goals

- Review risk factors for VTE
- Identify patients at high risk for post-thrombotic syndrome (PTS) and treatment options to prevent chronic venous disease
- Describe workup of patients with venous disease
- Review treatment options for patients with VTE

Big Picture

- Incidence of VTE is 1.6 per 1000
- Studies suggest 20-50% of patients with DVT develop post thrombotic syndrome (PTS) of which up to 10% can result in wounds

Pathophysiology

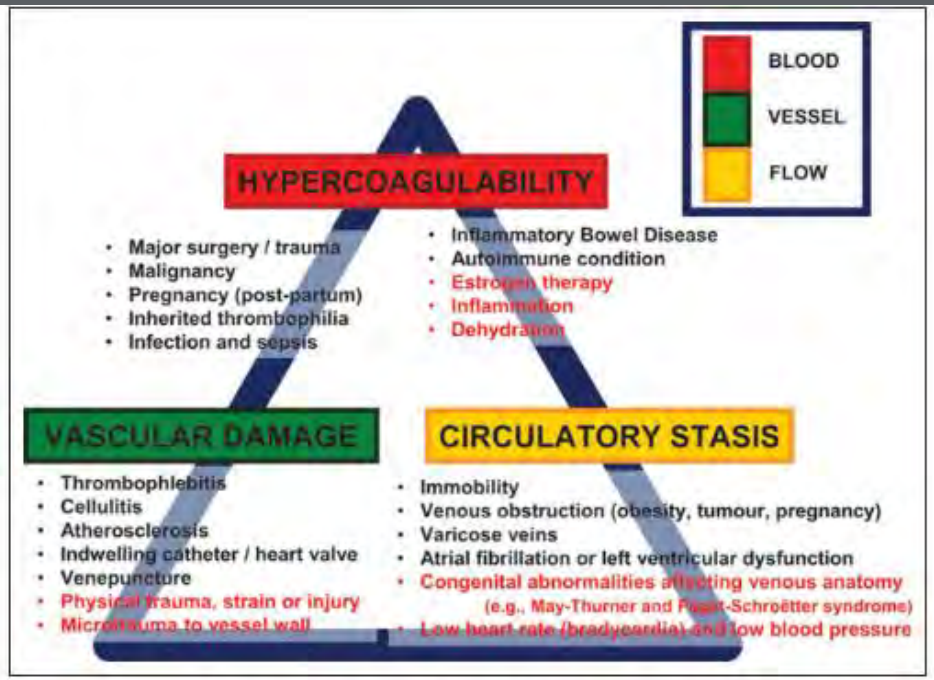

Figure. Virchow's triad of risk factors for venous thromboembolism (VTE). Factors in red are associated with heightened risk in marathon athletes. Note that athlete-specific factors are present in all 3 sections of the triad; a cumulative risk of VTE in certain individuals is entirely possible.

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The post thrombotic syndrome: Ignore it and it will come back to bite you

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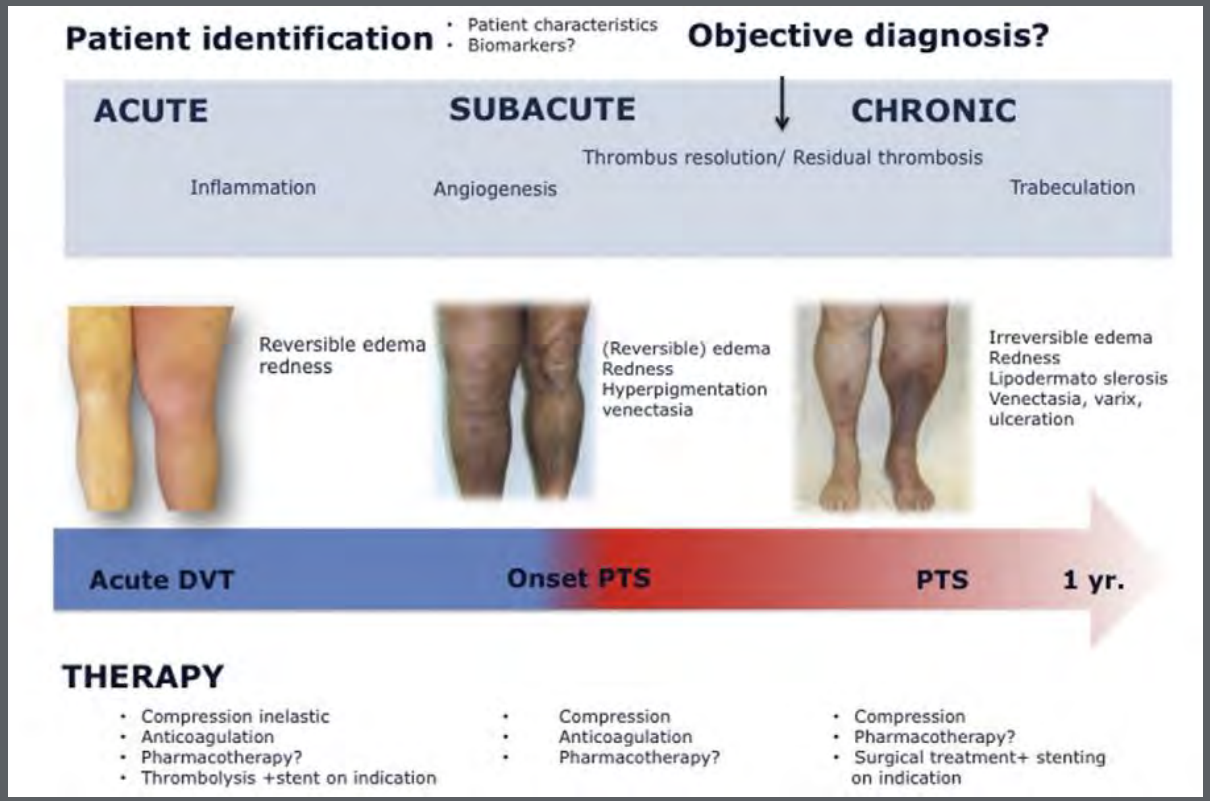
Post Thrombotic Syndrome (PTS)



Blood Reviews 30 (2016) 131–137

Post-Thrombotic Syndrome (PTS)

- No “gold” standard
- Clinical definition based on The Villalta scale
- Presents within a few months (2-4) of DVT
- 20-50% of patients with LE DVTs will develop PTS with 5-10% of them developing severe PTS

Table 1. Villalta PTS scale

Assessment of:	
• 5 symptoms (pain, cramps, heaviness, pruritus, paresthesia) by patient self-report • 6 signs (edema, skin induration, hyperpigmentation, venous ectasia, redness, pain during calf compression) by clinician assessment	
Severity of each symptom and sign is rated as 0 (absent), 1 (mild), 2 (moderate) or 3 (severe). In addition, ulcer is noted as present or absent.	
Points are summed to yield the total Villalta score:	
0-4:	No PTS
5-9:	Mild PTS
10-14:	Moderate PTS
≥15, or presence of ulcer	Severe PTS

PMID: 27913509

Risk factors of PTS

- Proximal DVT (iliac or common femoral) [2-3x risk of PTS]
- Previous ipsilateral proximal DVT
- History of ipsilateral venous insufficiency [2x risk of PTS]
- Obesity (BMI > 30) [2x risk of PTS]

PMID: 27913509

Describe workup of patients with venous disease

- Evaluation (H&P) with Exam
  - Conservative therapy (compression & elevation)
- Imaging (duplex, venography with IVUS, CTV, MRV)
  - Outflow obstruction
  - Reflux
    - Deep
    - Superficial
    - Combined
    - Perforator

Table 1. CEAP classification of chronic venous disease

Clinical Classification (C)		Etiologic Classification (E)	
C_0	No visible/palpable signs of venous disease	E_c	Congenital
		E_p	Primary
C_1	Telangiectasias or reticular veins	E_s	Secondary (postthrombotic)
C_2	Varicose veins	E_n	No venous etiology identified
C_3	Edema	**Anatomic Classification (A)**	
C_{4a}	Pigmentation and/or eczema	A_s	Superficial veins
		A_p	Perforator veins
C_{4b}	Lipodermatosclerosis and/or atrophy	A_d	Deep veins
C_5	Healed venous ulcer	A_n	No venous location identified
C_6	Open venous ulcer	**Pathophysiologic Classification (P)**	
		P_r	Reflux
	Subscript	P_o	Obstruction
A	Asymptomatic	$P_{r,o}$	Reflux and obstruction
S	Symptomatic	P_n	No venous pathophysiology identifiable

Source: Adapted from the 2011 Clinical Guidelines of the Society for Vascular Surgery and American Venous Forum (J Vasc Surg. 2011;53:2S-48S)

Who to treat?

CaVenT Trial: Study Design

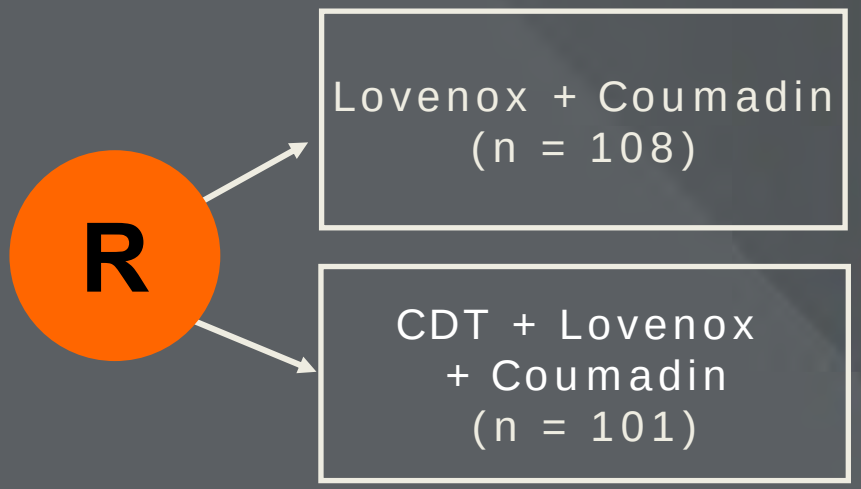
- Eligibility:

Age: 18-75 years

First-time acute iliofemoral DVT

Symptom duration up to 21 days

No increased risk of bleeding



- Primary outcomes:
  - Frequency of PTS at 24 months, assessed by the Villalta score
  - Iliofemoral patency after 6 months

Enden T et al. *Lancet* 2012;379(9810):31-8.

Outcomes: Additional CDT versus Standard Therapy

Outcome	Additional CDT (n = 90)		Standard therapy only (n = 99)		*p*-value
	n	% (95% CI)	n	% (95% CI)	
PTS after 6 mo	27	30.3 (21.8-40.5)	32	32.2 (23.9-42.1)	0.77
PTS after 24 mo	37	41.1 (31.5-51.4)	55	55.6 (45.7-65.0)	0.047
Iliofemoral patency after 6 mo	58	65.9 (55.5-75.0)	45	47.4 (37.6-57.3)	0.012

- PTS is defined as a Villalta score ≥5.
- *p*-values stated are from an unadjusted Chi-square test.
- Absolute risk reduction of long-term endpoint PTS at 24 months of follow-up in CDT versus standard therapy: 14.4% (95% CI 4-502).

Enden T et al. *Lancet* 2012;379(9810):31-8.

Who to treat?

- Proximal DVT (iliac to common femoral vein)
- Recurrent ipsilateral DVT
- Obese patients

- Relative risk reduction of 23% at 5 yrs for PTS (71% vs. 43%)

DVT Treatment

	Risk of Bleeding	Rate of Thrombus Clearance	ICU stay	Length of Stay post-op
Systemic Heparin	Low	Low	No	N/A
Percutaneous Mechanical Thrombectomy	Low	Rapid	No	1-2
Catheter Directed Thrombolysis (CDT)	Moderate (17 of 150 pts w/ bleeding in Seattle II study, 11%)	Moderate	Yes (~2 days)	1-2
Systemic TPA	High	Rapid	Yes (~ 1 day)	1-2

DVT Treatment

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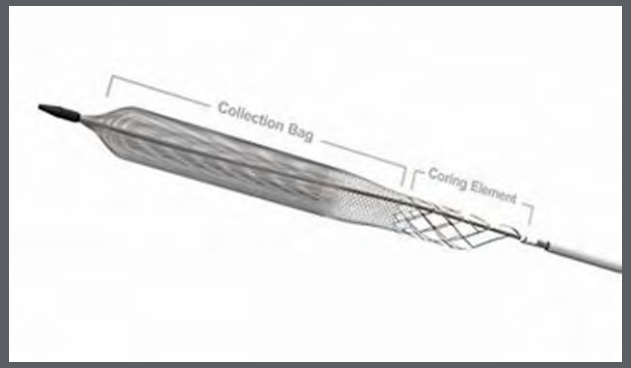
Percutaneous Mechanical Thrombectomy

Penumbra

- Aspiration catheter
- Separator wire to fragment clot

Inari



- Mechanical thrombectomy with coring element
- Aspiration sheath

Angiojet

- Aspiration catheter with TPA spray

Case example

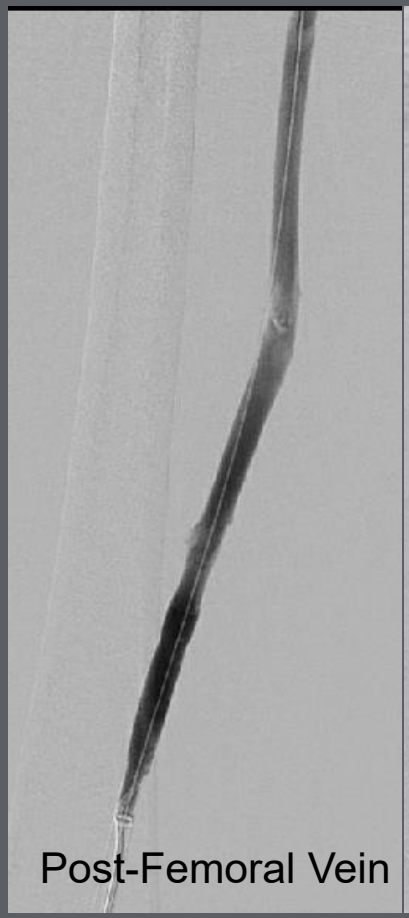
- 42 yo F w/ LLE swelling over 2 weeks with LE venous duplex with common femoral to ankle DVT. CT a/p venous phase with left common and external iliac vein DVT

Benefits:
- Minimal sedation needed
- Large clot (acute & chronic) evacuation
- Can stent (for iliac vein compression)
- Minimal blood loss (< 100cc)
- Single session treatment

Risks:
- Popliteal vein access (prone)
- Large bore venous access

Procedure

- Awake with light sedation in the prone position
- Case duration ~70 mins, EBL 50cc



Case example

- 51 yo M w/ RLE swelling over 12 hours with decreased motor and sensation to the right foot.

- BLE venous duplex with right iliac to ankle DVT
- Diagnosis?

Phlegasia Cerulea Dolens

Procedure

- Awake, minimal sedation, prone position
- Case duration 90 mins, EBL 50cc

Post-Femoral Venogram

Post Stenting Iliac Venogram

Post Stenting Femoral Venogram

Pre-Op

POD1

IVC Occlusions

- 32 yo F w/ abd pain 3 weeks s/p ureteroscopy, laser lithotripsy, and stent placement for a renal stone. Found on CT to have an IVC thrombus (Panels A and B). Treated with heparin x 48 hours with worsening BLE swelling.
- Taken for percutaneous mechanical thrombectomy (panel C)
- CT venogram 30d post-op with a patent IVC, bilateral iliac, and femoral veins (Fig 1d and e, blue arrows).
- Outpatient testing revealed a factor V Leiden mutation.

DVT – Treatment Algorithm

- Positive lower extremity venous duplex with common femoral DVT
- CT abdomen/pelvis with contrast (venous phase) to identify evidence of IVC, common or external iliac vein DVT
- Currently offering treatment to patients with IVC, iliac vein, and/or common femoral vein DVT

Proximal Extension of DVT

62 yo M w/ 3d h/o RLE swelling and CTA w/ subsegmental bilateral PEs. No h/o prior DVTs. Sat 97% on RA.

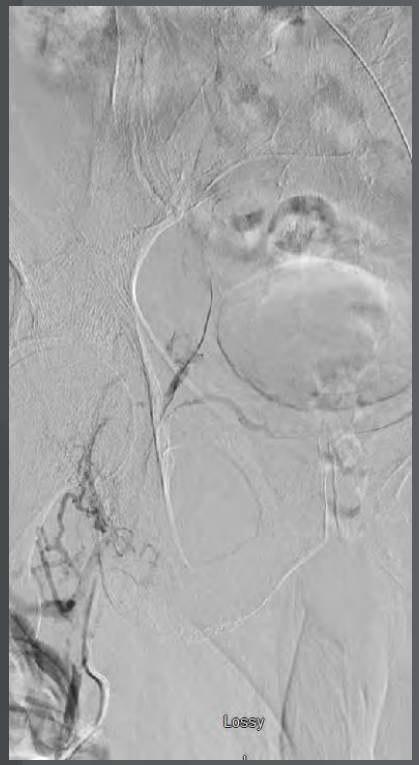
Segment	Right					
	Spont	Ph	Aug	Compr	Thromb	SI
CFV	None	None	Absent	None	Acute	Occluded
DFV	None	None	Absent	Partial	Acute	Partially Occluding
FV Prox	Decreased	Decreased	Decreased	Partial	Acute	Partially Occluding
FV Mid	Decreased	Decreased	Decreased	Partial	Acute	Partially Occluding
FV Dist	Decreased	Decreased	Decreased	Partial	Acute	Partially Occluding
POPV	Decreased	Decreased	Decreased	Partial	Acute	Partially Occluding
Gastrocnemius	None	None	Absent	Partial	Acute	Partially Occluding
PTV	None	None	Absent	None	Acute	Occluded
PERV						Not Visualized
GSV Prox	None	None	Absent	None	Acute	Occluded

Segment	Left					
	Spont	Ph	Aug	Compr	Thromb	SI
CFV	Normal	Phasic	Normal	Complete	None	Normal (Patent)

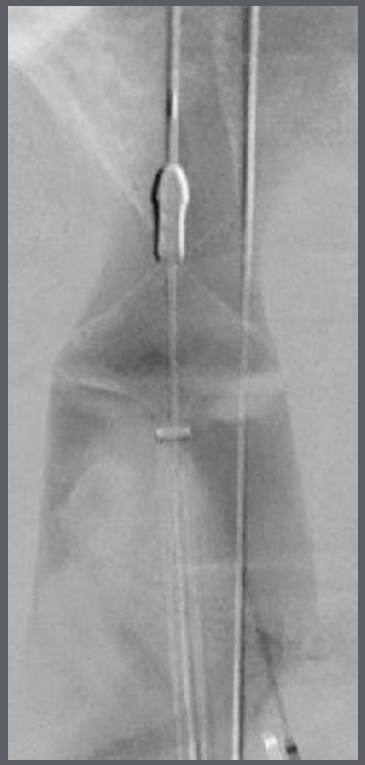
Procedure

- Awake, MAC sedation, supine position
- Case duration 126 mins, EBL 150cc

Pre-Iliac Venogram



Temp IVC Filter



Post Thrombectomy

Contemporary Iliac DVT invasive management: Lower Post-Thrombotic Syndrome Incidence Than Ever Before.

MVSS 2024 – 9/12/24

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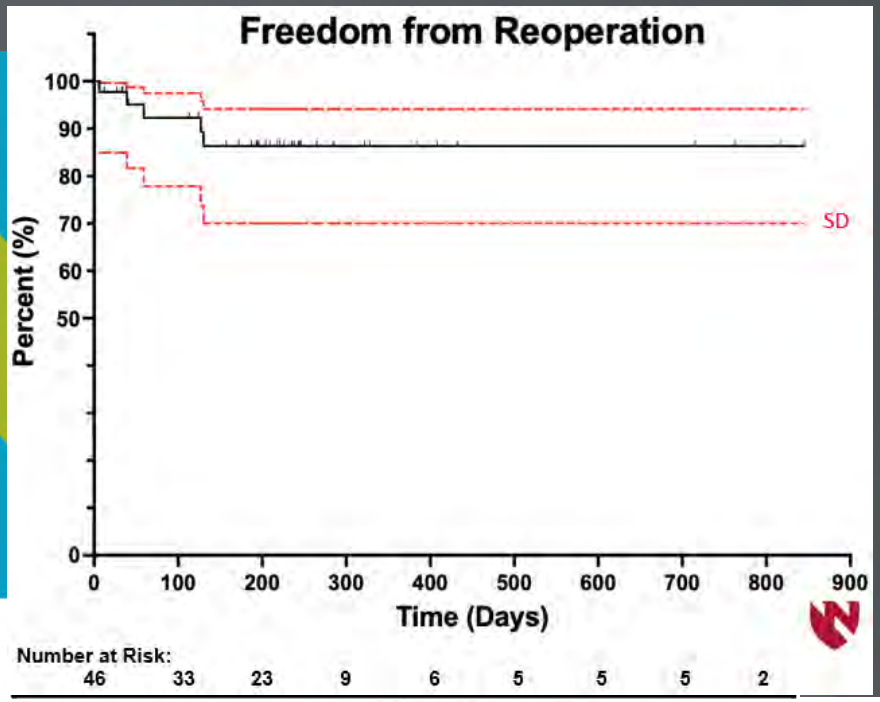

Follow up data - Ultrasound

	Preop N=46	1 month N= 42	6 months N=31
IVC			
Patent	42 (91%)	40 (95%)	31 (100%) *
Occluded	4 (9%)	2 (5%)	0 *
Iliac Vein			
Patent	0 (0%)	40 (95%)	28 (91%)
Occluded	46 (100%)	2 (5%)	3 (10%)
Common Femoral			
Patent	7 (16%)	40 (95%)	30 (97%)
Occluded	39 (84%)	2 (5%)	1 (3%)

*: Previously occluded IVC at 1 month not surveyed with US at 6 months; 1 patient with IVC atresia, 1 patient with chronically occluded IVC filter

Assessment at Last Follow-up

Edema	
None	33 (72%)
Mild	7 (15%)
Moderate	6 (13%)
Pain	
None	41 (89%)
Mild	4 (9%)
Moderate	1 (2%)
PTS Villalta >4	3 (6.5%)
Median Follow-up (Days)	221 (140.5,303.5)

Unpublished

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Thank you

Adverse Events (AEs)

AEs	Additional CDT (n = 101)	Standard treatment (n = 108)
Bleeding complications	20	0
Major bleeding complications	3	0
Clinically relevant bleeding complications	5	0
Deaths	0	NR
Pulmonary embolisms	0	NR
Cerebral hemorrhages	0	NR
Nonbleeding complications	4	NR
Recurrent VTE at 24 mo	10	18

Enden T et al. *Lancet* 2012;379(9810):31-8.