

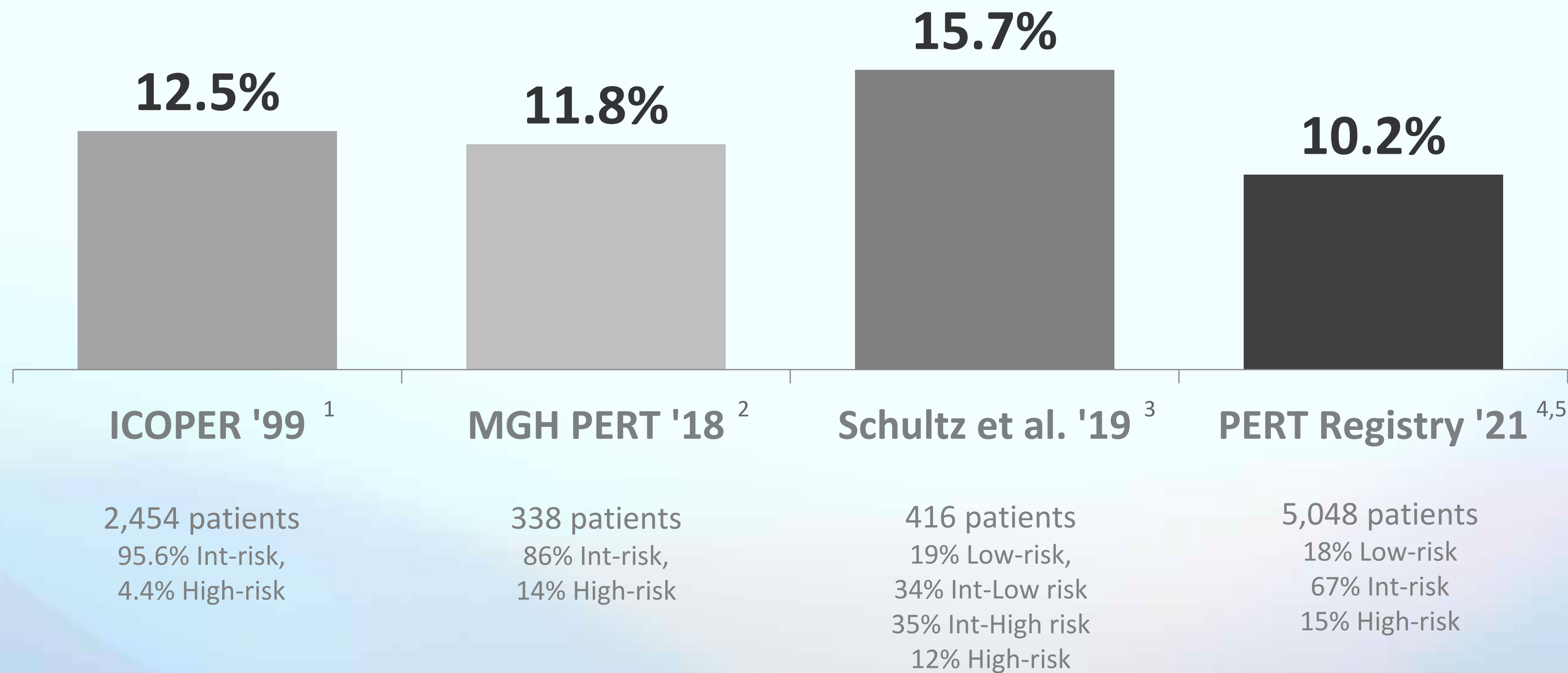
Beyond Anticoagulation: Multidimensional Treatment Approaches for Venous Thromboembolism

Pulmonary Embolism

- Third most common cause of cardiovascular death
- Increasing incidence with age
- Patients with submissive and massive typically are more ill than they appear
- Long term effects can be severely debilitating
 - Chronic thromboembolic pulmonary hypertension (0.4%-4.8%)
 - Chronic thromboembolic disease (up to 11% with NYHA III-IV symptoms)

Mortality in PE patients has not improved much over 20 years

All-Cause Mortality @ 30-days in PE Patients



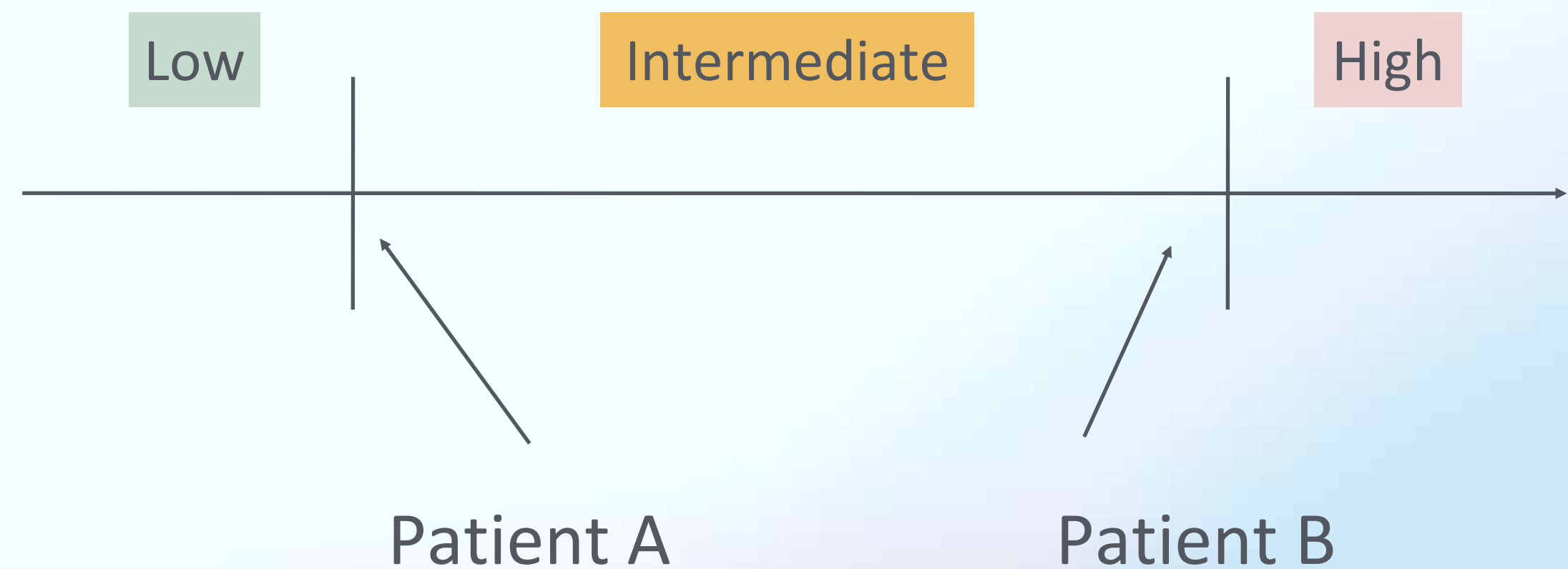
By risk level:
6-15%¹⁻⁵
 in submassive PE patients

25-50%¹⁻⁵
 in massive PE patients

1. Kucher N, et al. Massive pulmonary embolism. Circulation. 2006 Jan 31;113(4):577-82.
2. Secemsky E, et al. Contemporary Management and Outcomes of Patients with Massive and Submassive Pulmonary Embolism. Am J Med. 2018 Dec;131(12):1506-1514.e0
3. Schultz J, et al. A Multidisciplinary Pulmonary Embolism Response Team (PERT) - Experience from a national multicenter consortium. Pulm Circ. 2019 Jan 11;9(3):2045894018824563
4. PERT Consortium Quality Database. October 2021 (Presented by Secemsky E)
5. Darki A & Jaber WA. Endovascular Today. July 2022 Supplement (PERT Updates)

Pulmonary Embolism Classification

- High Risk
- Intermediate Risk
 - High Risk Intermediate
 - Low Risk Intermediate
- Low Risk



Pulmonary Embolism Stratification

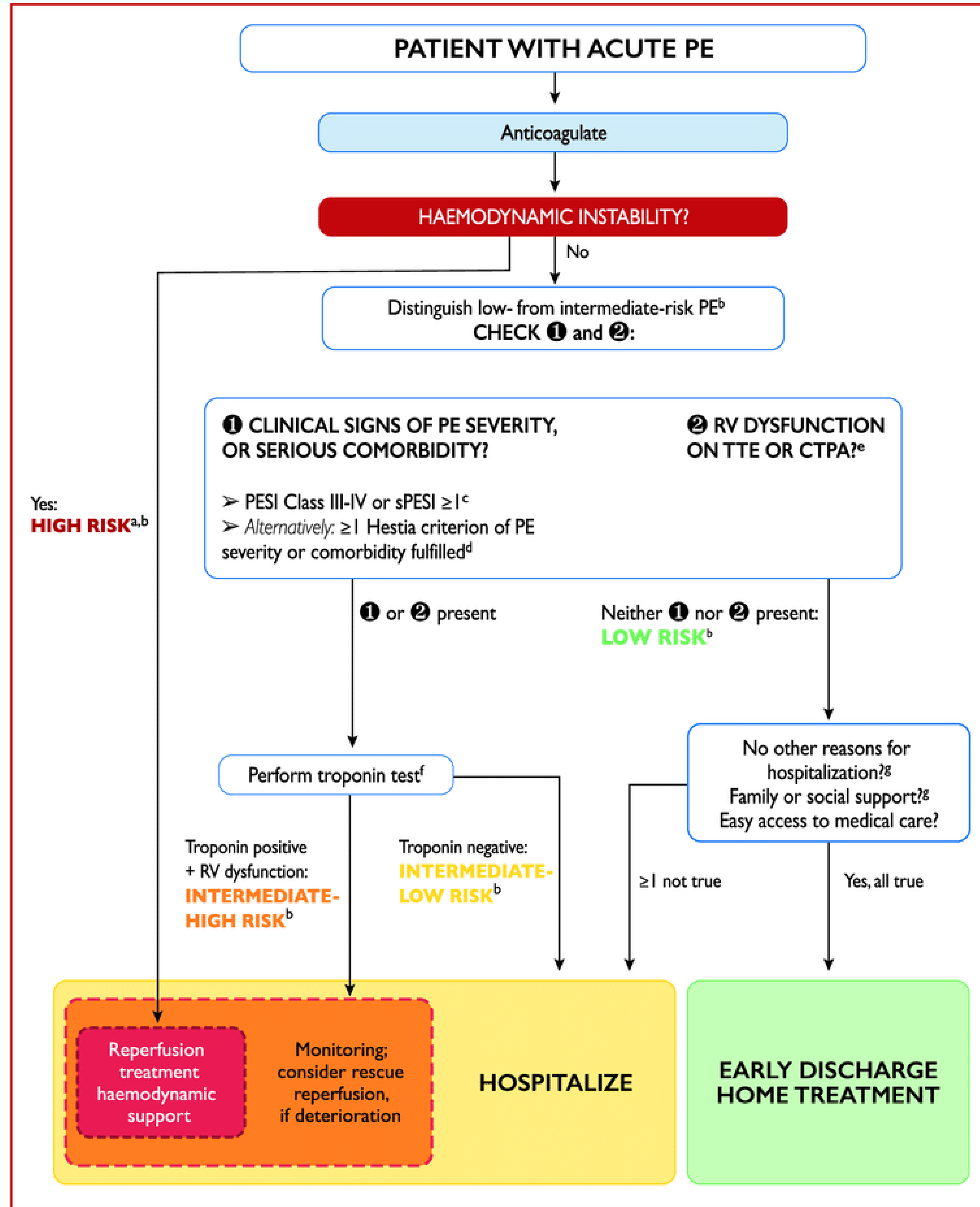
Early mortality risk		Indicators of risk			
		Haemodynamic instability ^a	Clinical parameters of PE severity and/or comorbidity: PESI class III–V or sPESI ≥1	RV dysfunction on TTE or CTPA ^b	Elevated cardiac troponin levels ^c
High		+	(+) ^d	+	(+)
Intermediate	Intermediate–high	-	+ ^e	+	+
	Intermediate–low	-	+ ^e	One (or none) positive	
Low		-	-	-	Assesment optional; if assessed, negative

Changes to Guidelines

Recommendations	2014	2019
Rescue thrombolytic therapy is recommended for patients who deteriorate haemodynamically.	IIa	I
Surgical embolectomy or catheter-directed treatment should be considered as alternatives to rescue thrombolytic therapy for patients who deteriorate haemodynamically.	IIb	IIa
D-dimer measurement and clinical prediction rules should be considered to rule out PE during pregnancy or the post-partum period.	IIb	IIa
Further evaluation may be considered for asymptomatic PE survivors at increased risk for CTEPH.	III	IIb

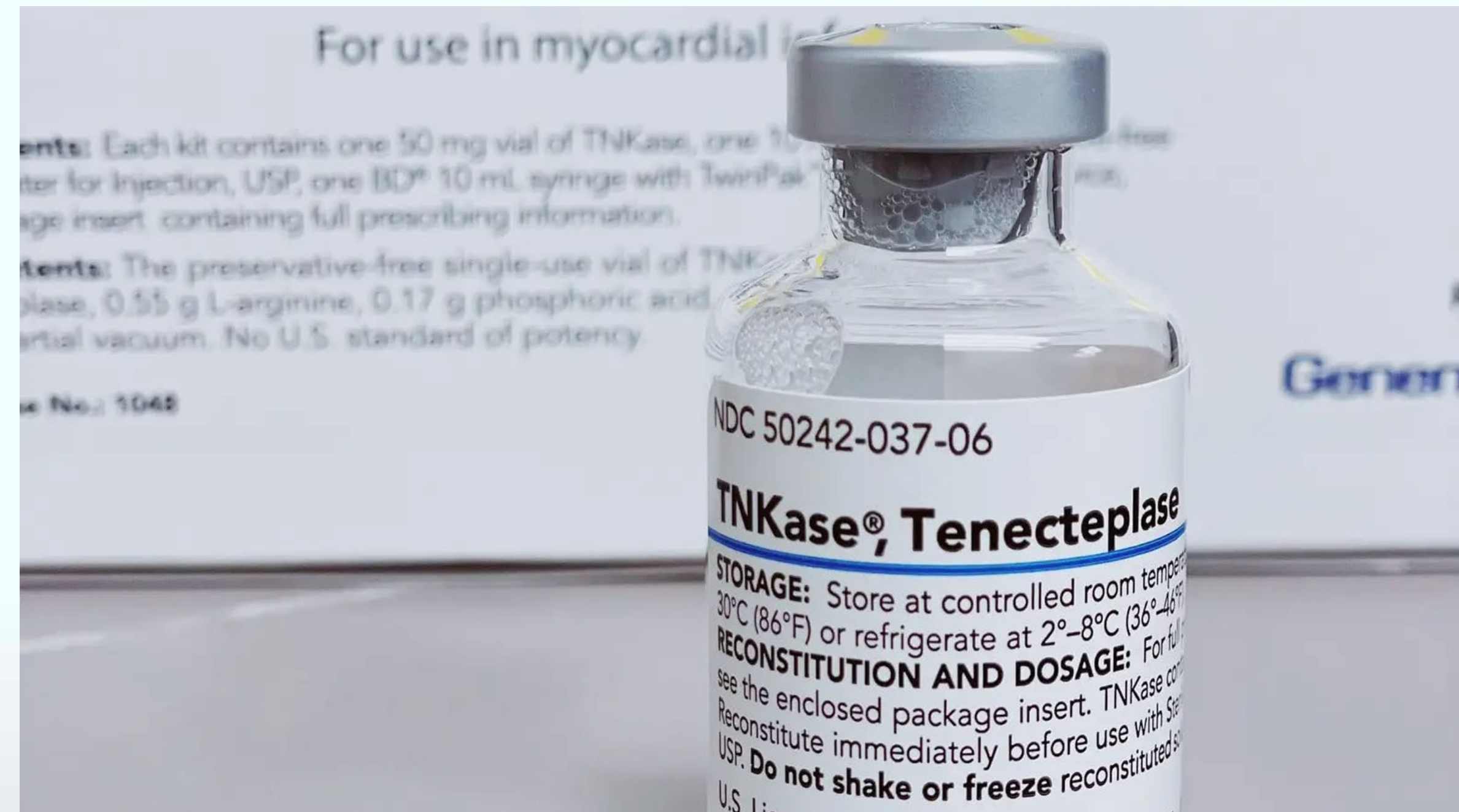
Guideline Updates

Risk assessment	
Assessment of the RV by imaging or laboratory biomarkers should be considered, even in the presence of a low PESI or a sPESI of 0.	IIa
Validated scores combining clinical, imaging, and laboratory prognostic factors may be considered to further stratify PE severity.	IIb
Treatment in the acute phase	
When oral anticoagulation is initiated in a patient with PE who is eligible for a NOAC (apixaban, dabigatran, edoxaban, or rivaroxaban), a NOAC is the recommended form of anticoagulant treatment.	I
Set-up of multidisciplinary teams for management of high-risk and selected cases of intermediate-risk PE should be considered, depending on the resources and expertise available in each hospital.	IIa
ECMO may be considered, in combination with surgical embolectomy or catheter-directed treatment, in refractory circulatory collapse or cardiac arrest.	IIb



Treatment Options Beyond Anticoagulation

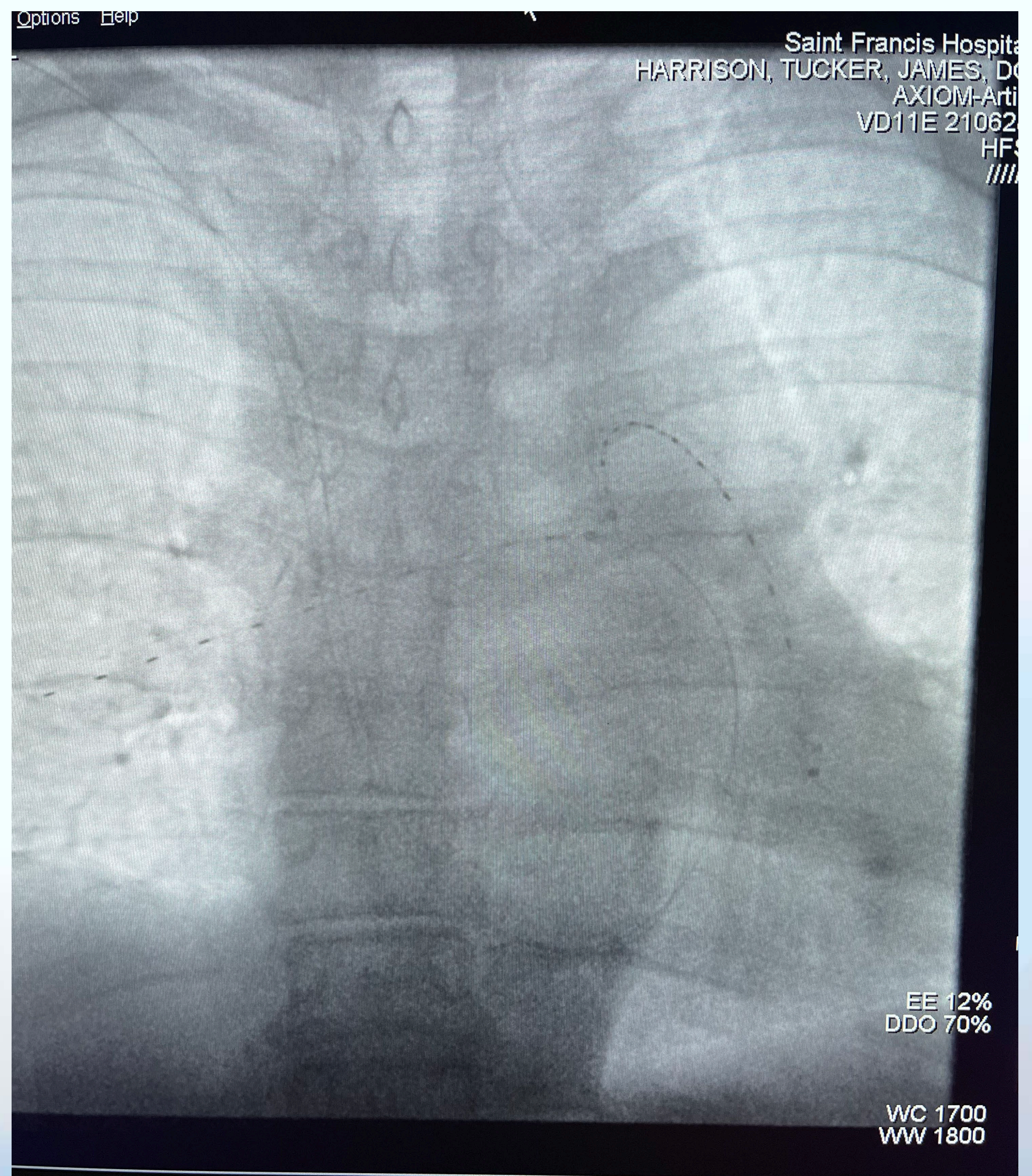
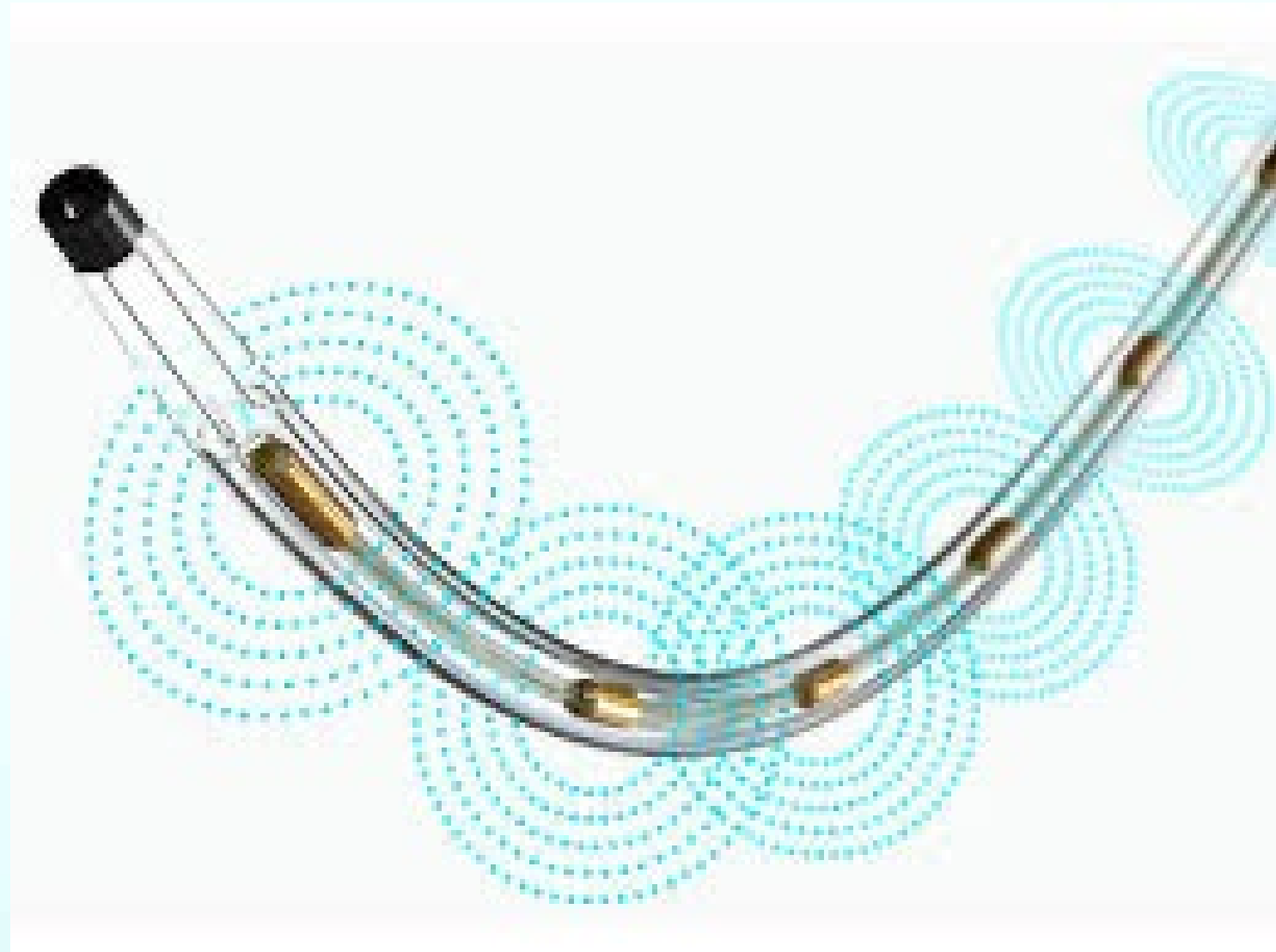
- Thrombolysis
 - Systemic
 - Catheter Directed
 - Multihole
 - Ultrasound Assisted
- Thrombectomy/Embolectomy
 - Catheter based
 - Surgical



Catheter Directed Thrombolysis

- Multihole catheter with or with ultrasonic pulsation
- Ultima (Reduction in RV/LV ratio with no increased bleeding EKOS vs AC)
- SEATTLE - 2 (Prospective single arm safety and efficacy)
- OPTAYLYSE PE (Dosing trial)
- PERFECT Trial (CDT vs historical, safe and effective)

Pulmonary EKOS

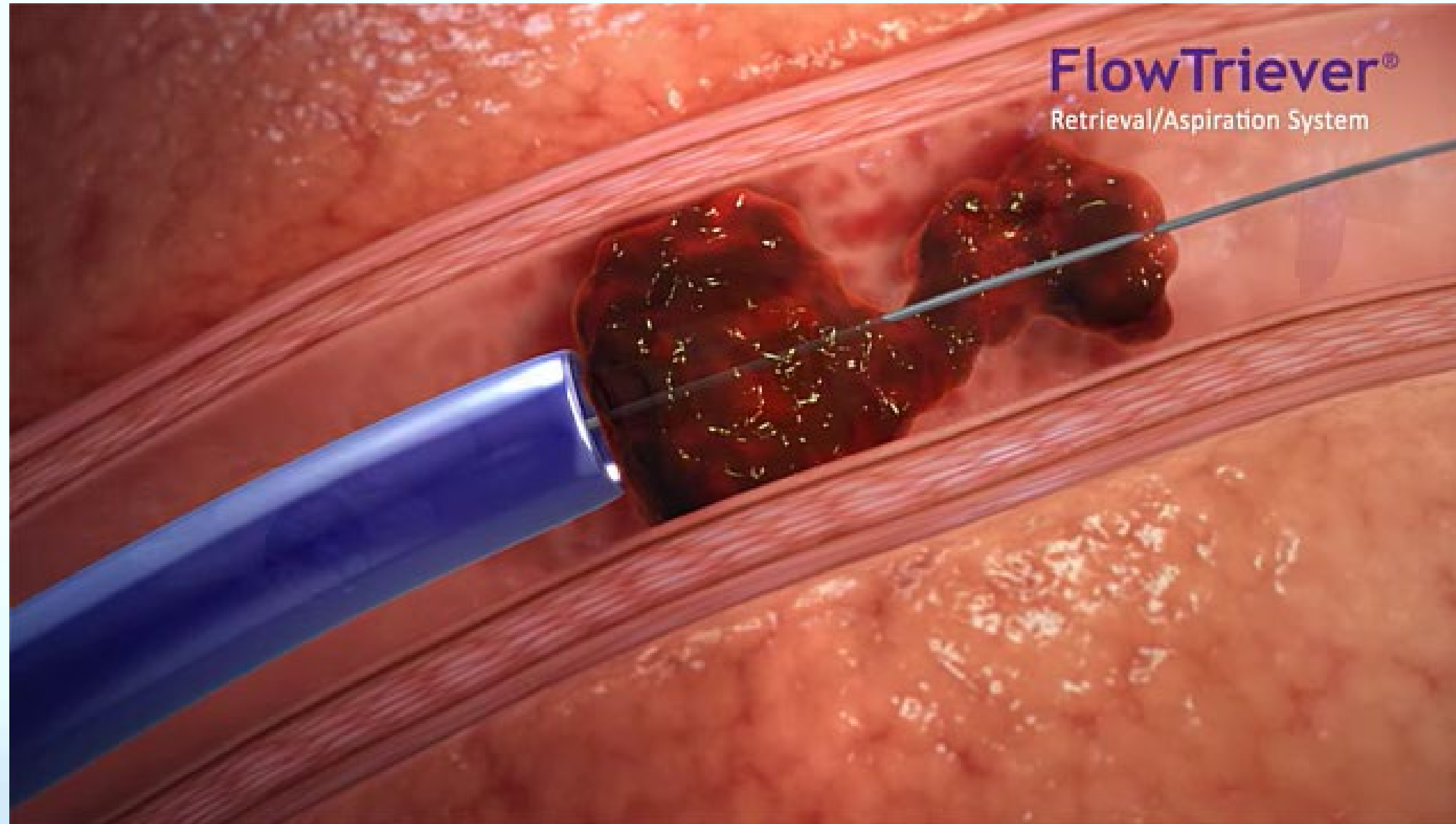


Mechanical Thrombectomy

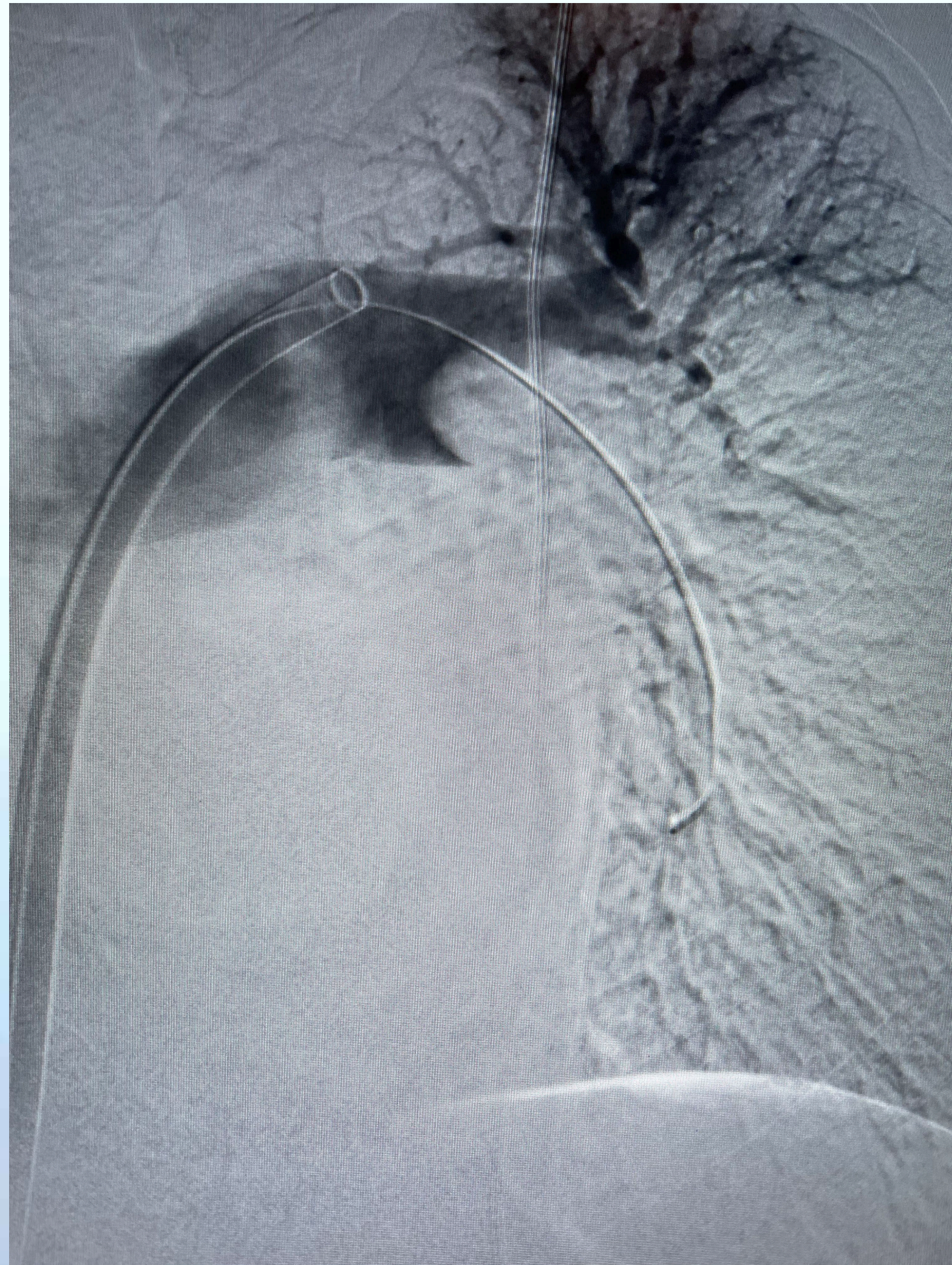
- Large bore
- Small bore
- Continuous suction
- Intermittent aspiration
- Combinations with maceration tools



Large Bore Removal



Left Pulmonary Angiogram



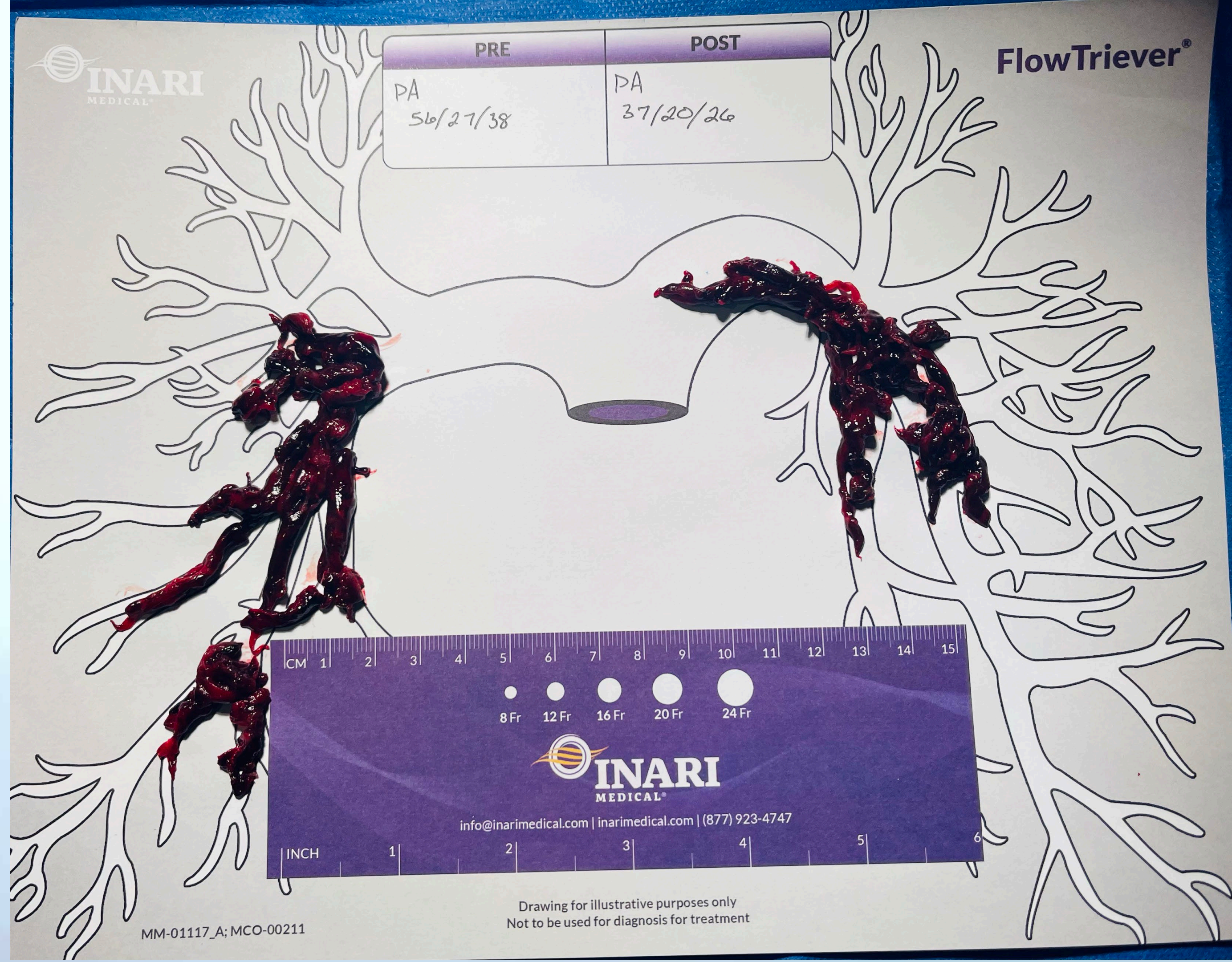
Right Pulmonary Angiogram





PRE	POST
PA 56/27/38	PA 37/20/26

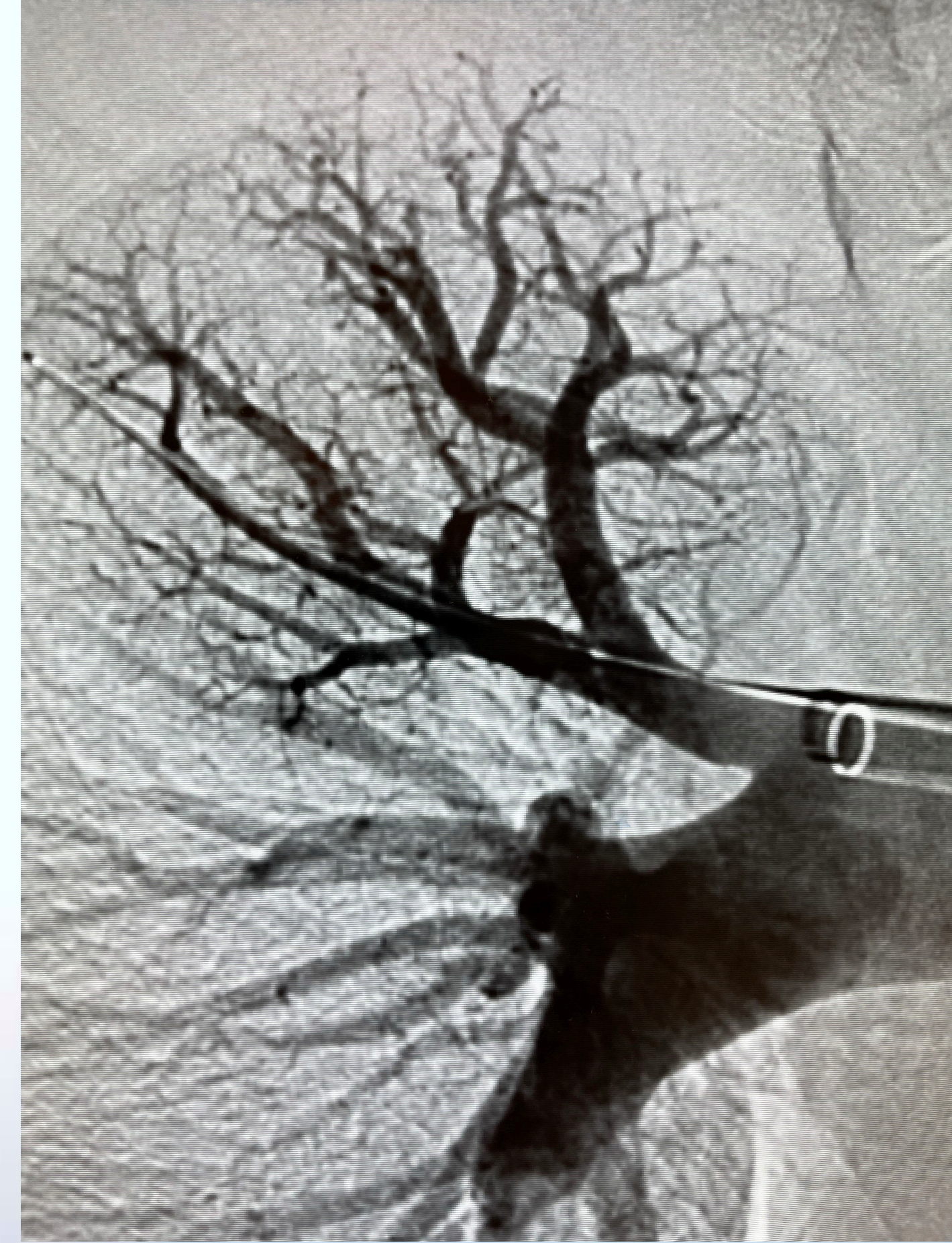
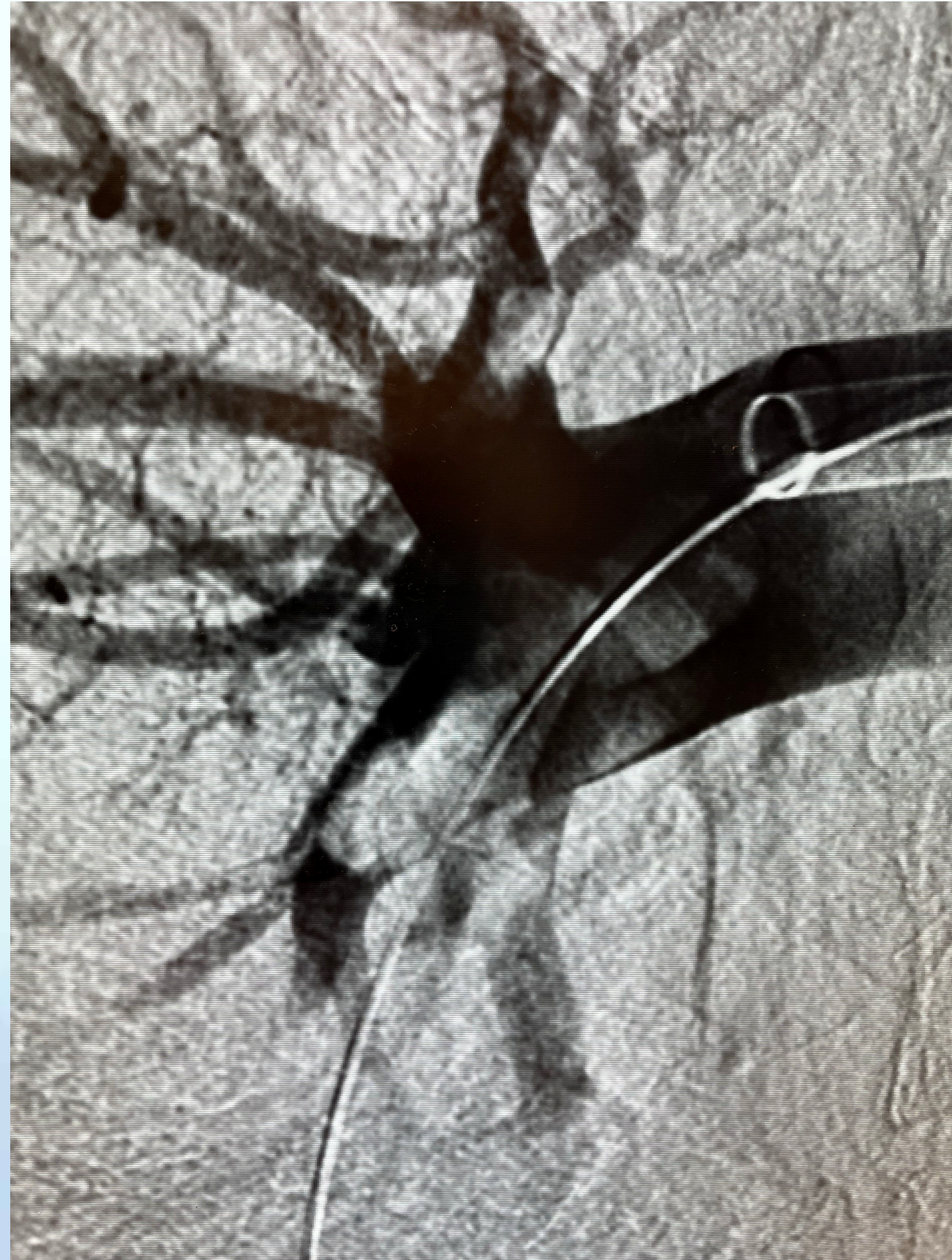
FlowTrieve[®]



MM-01117_A; MCO-00211

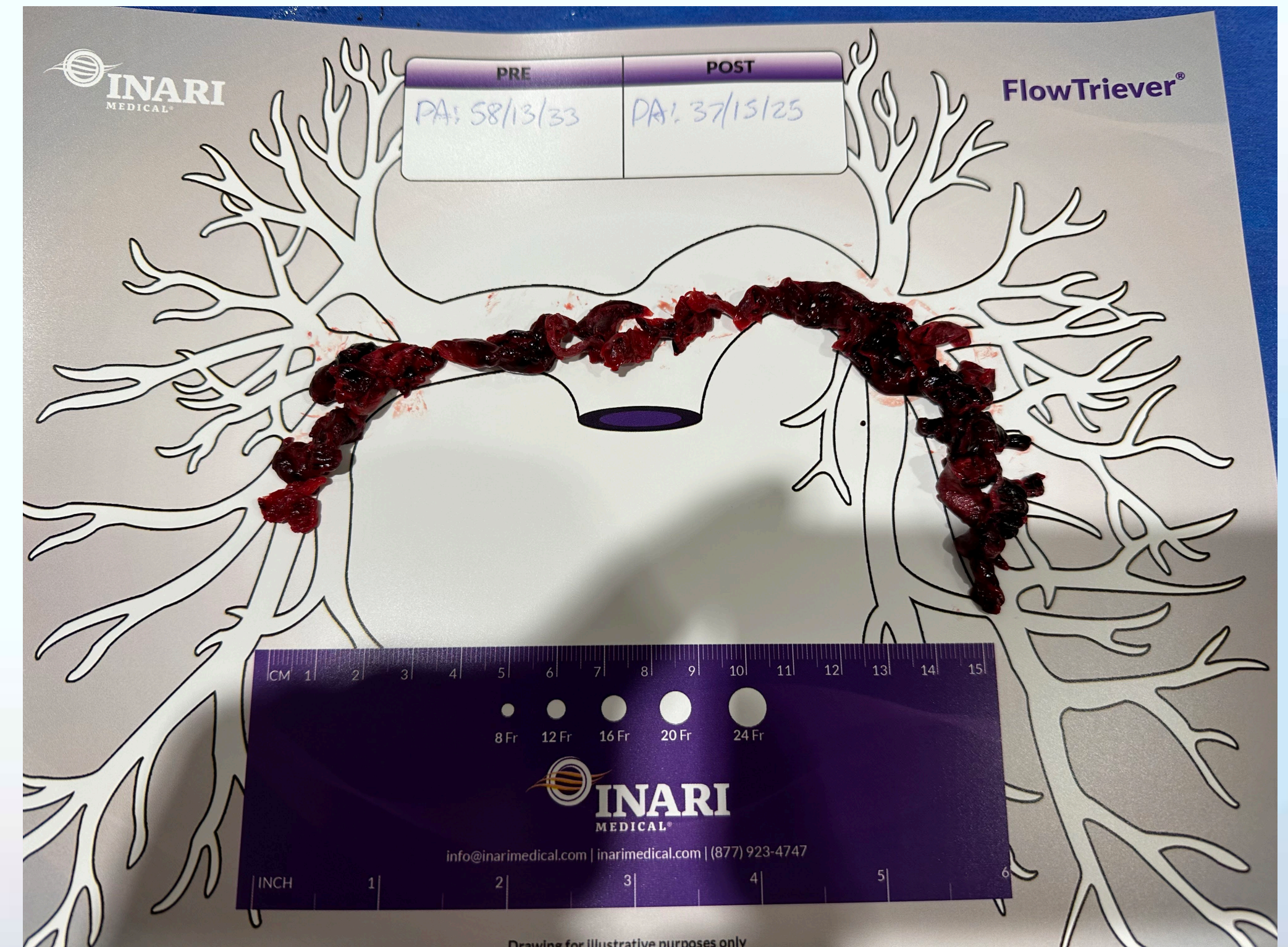
Drawing for illustrative purposes only
Not to be used for diagnosis for treatment

Right Pulmonary Embolism



Flow Triever

- Flash 800 (Registry)
 - Intermediate and High risk
 - 1.8% MACE with no deaths
 - <1% 30 Day mortality
- Flame Trial
 - Observation prospective trial in massive PE
 - Mechanical Thrombectomy lower mortality



REAL PE

Presented at TCT 2023

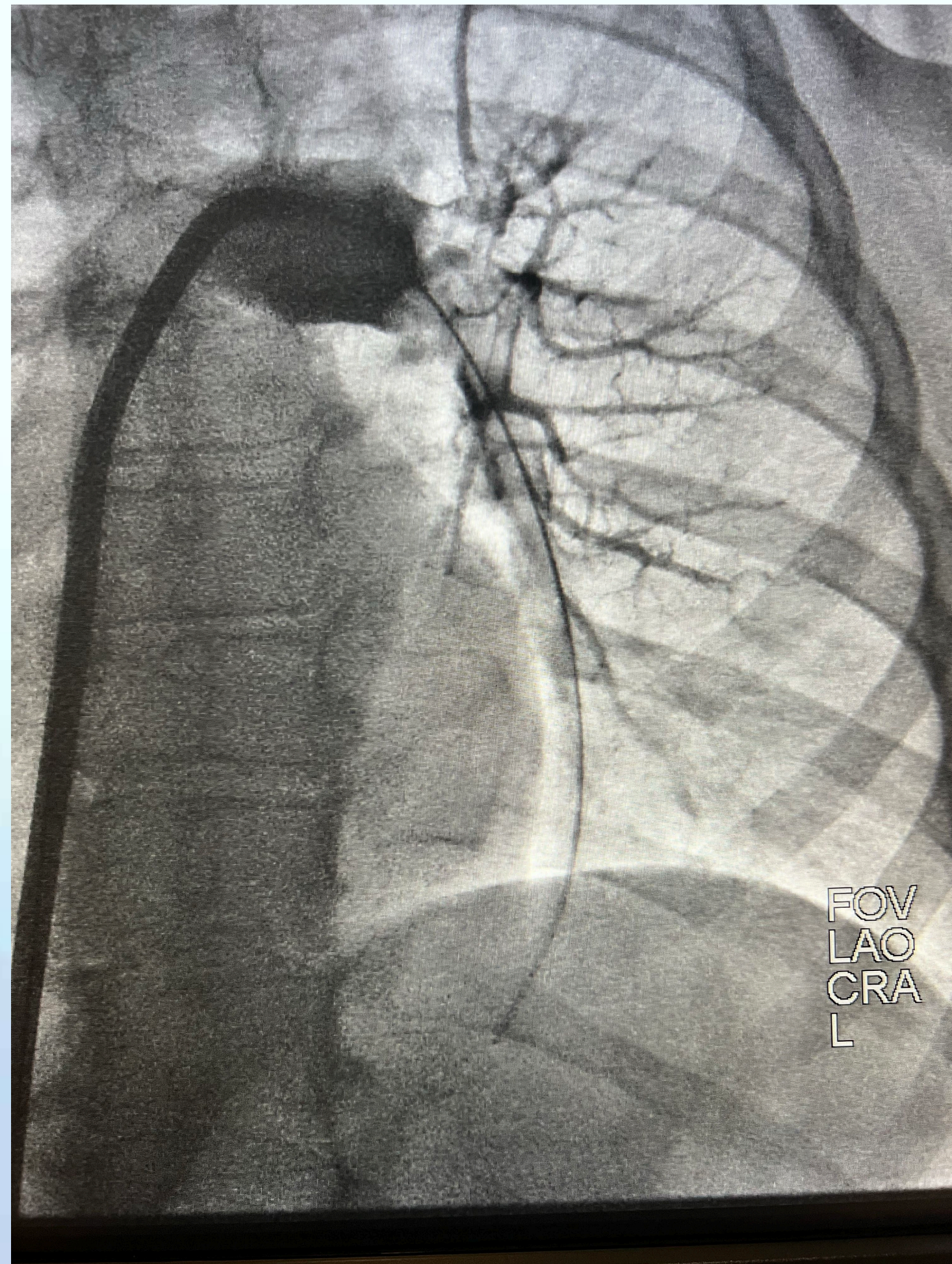
- Review of electronic health record
- Patients treated with EKOS or Flow Triever
- May 2009-May 2023
- No change in readmission or death
- Less major bleeding with EKOS



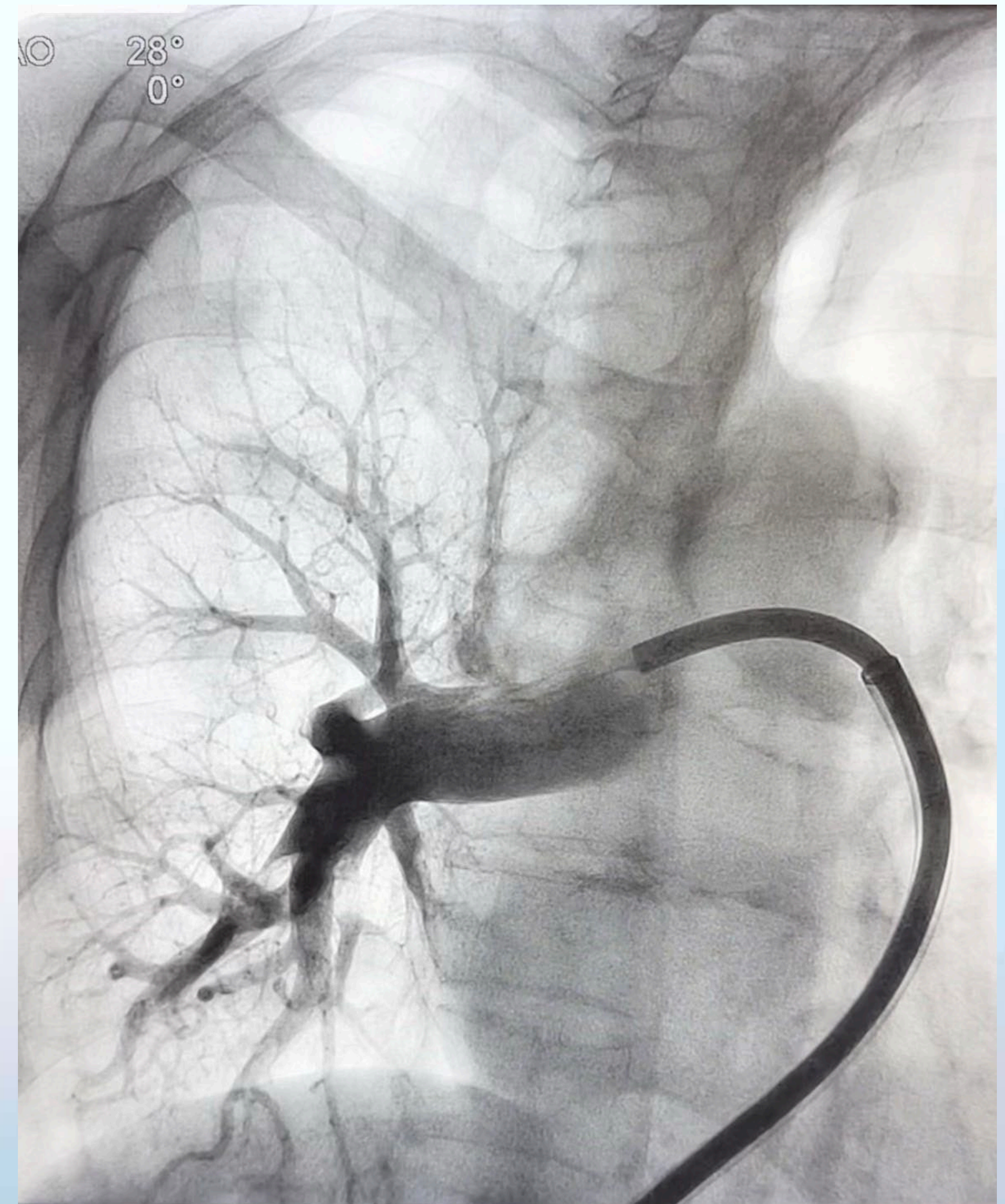
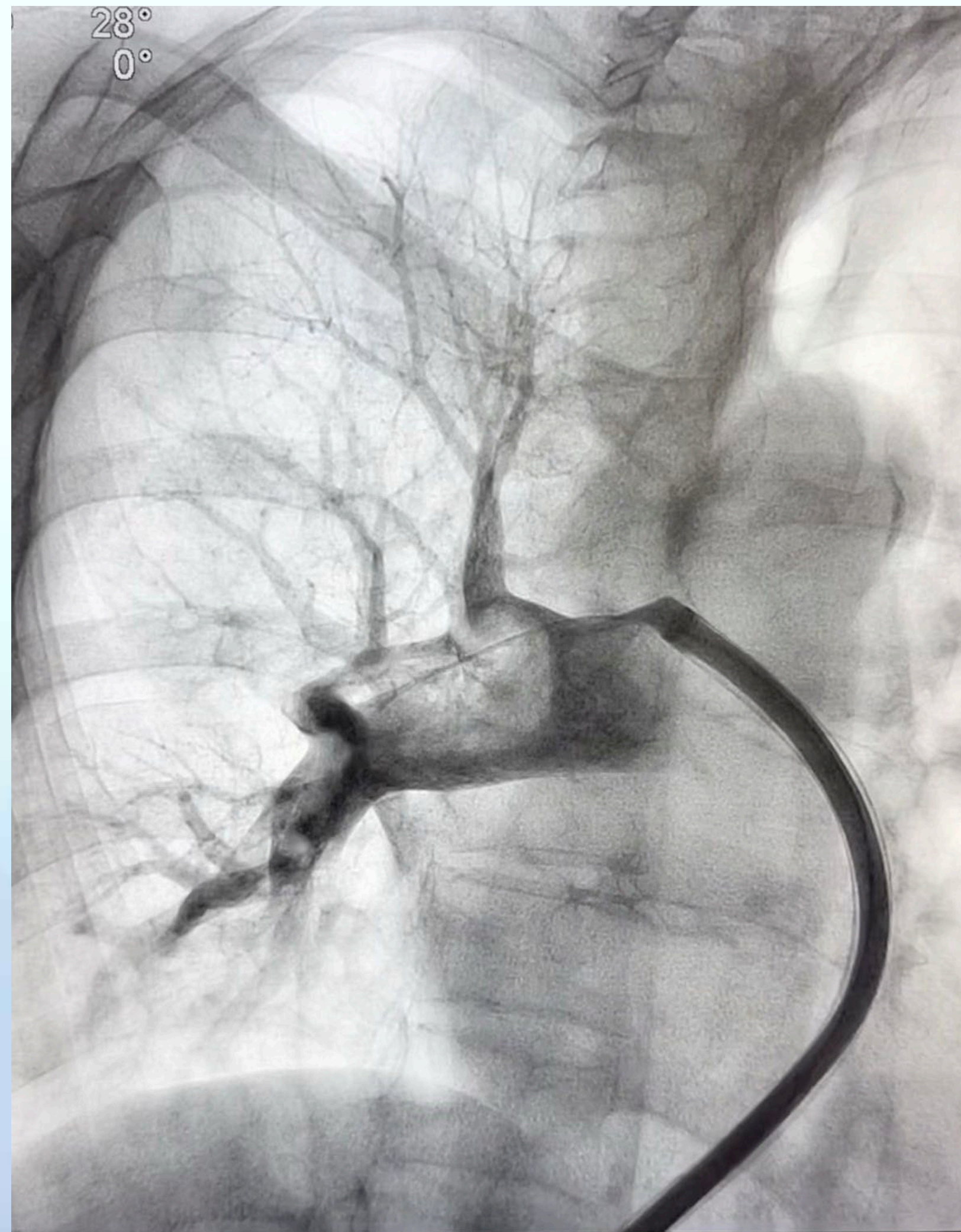
Small Bore Thrombectomy



Left Pulmonary Thrombectomy



Right Pulmonary Thrombectomy



Penumbra PE Trial

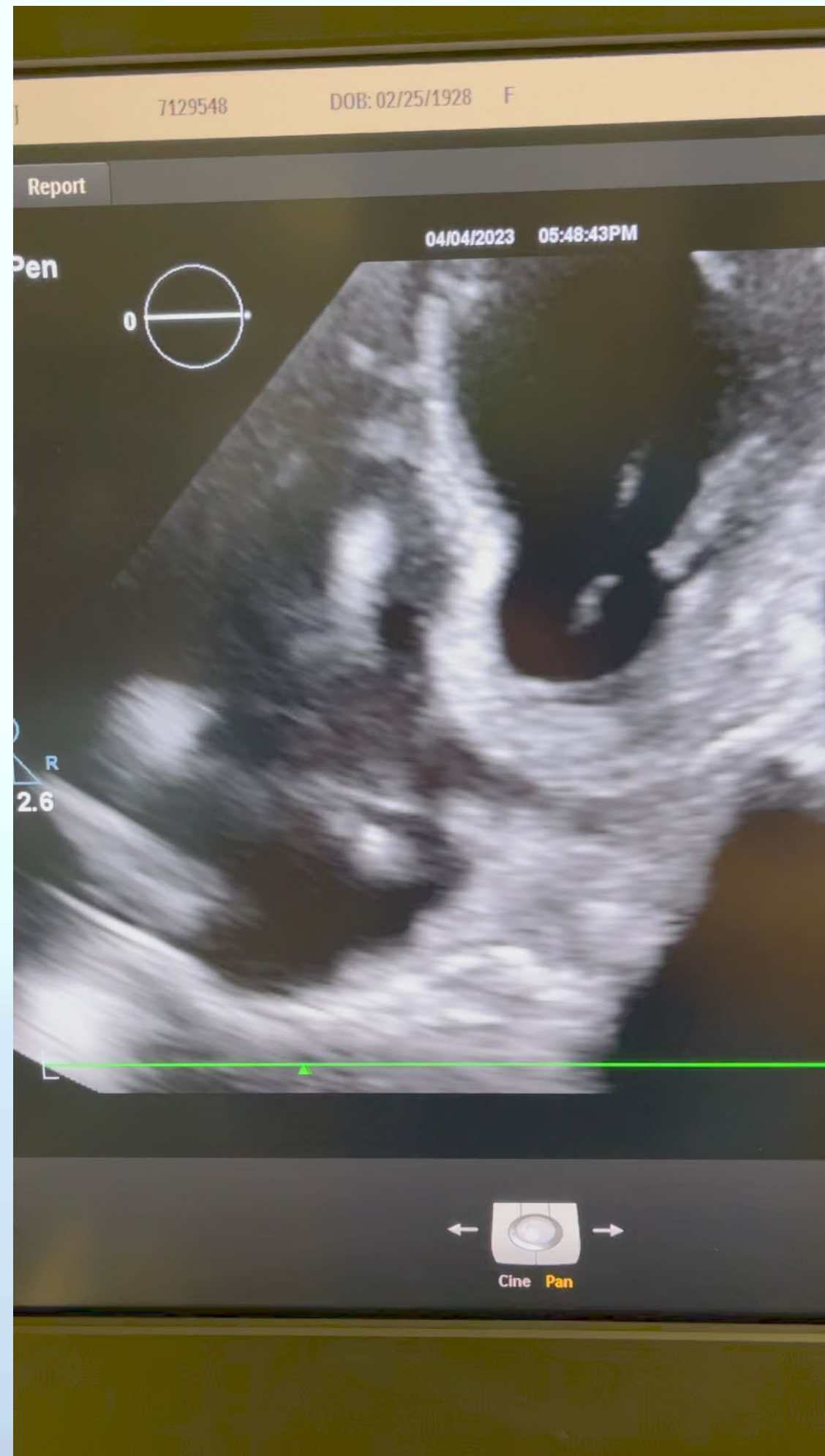
- EXTRACT PE
 - Multi-center prospective efficacy and safety trial
 - Reduced LV/RV ratio
 - Low event rate (1.7%)

Upcoming Data

- HI-PEITHO (Ongoing head to head RCT of EKOS versus AC)
- STORM PE (RCT Penumbra versus AC High risk submissive)
- STRIKE PE (Single arm prospective trial Penumbra for long term outcomes)
- PEERLESS I (RCT FlowTrievers vs CDT) **Coming this summer**
- PEERLESS II (RCT FlowTrievers vs heparin)

Clot in Transit

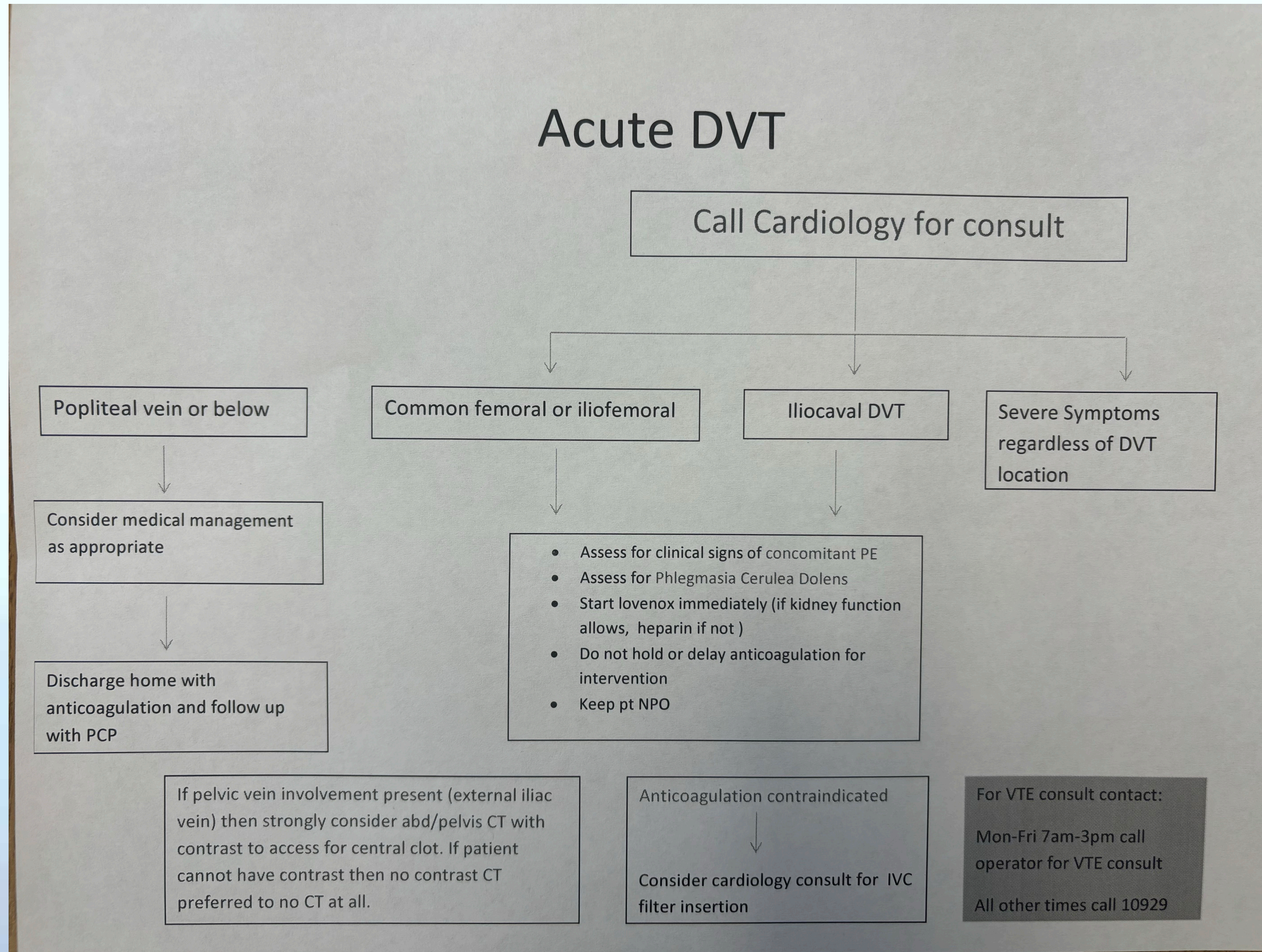
Flow Triever



Deep Vein Thrombosis

- Common condition (1.6 per 1000 annually)
- Up to 50% of central DVT can lead to post thrombotic syndrome (PTS)
- Severe PTS quality of life similar to heart failure and cancer
- Few guidelines regarding treatment

Treatment Algorithm



Treatment Options

- Catheter Directed Thrombolysis (CDT)
- Rheolytic Thrombectomy
- Suction Thrombectomy
- Mechanical Thrombectomy



ATTRACT Trial

- RCT Iliofemoral DVT (2017)
- Anticoagulation versus anticoagulation plus thrombectomy
- No difference in post thrombotic syndrome
- Increased bleeding
- Improvement in early quality of life
- Flawed by older technology and less symptomatic patients

CDT and Rheolytic Thrombectomy

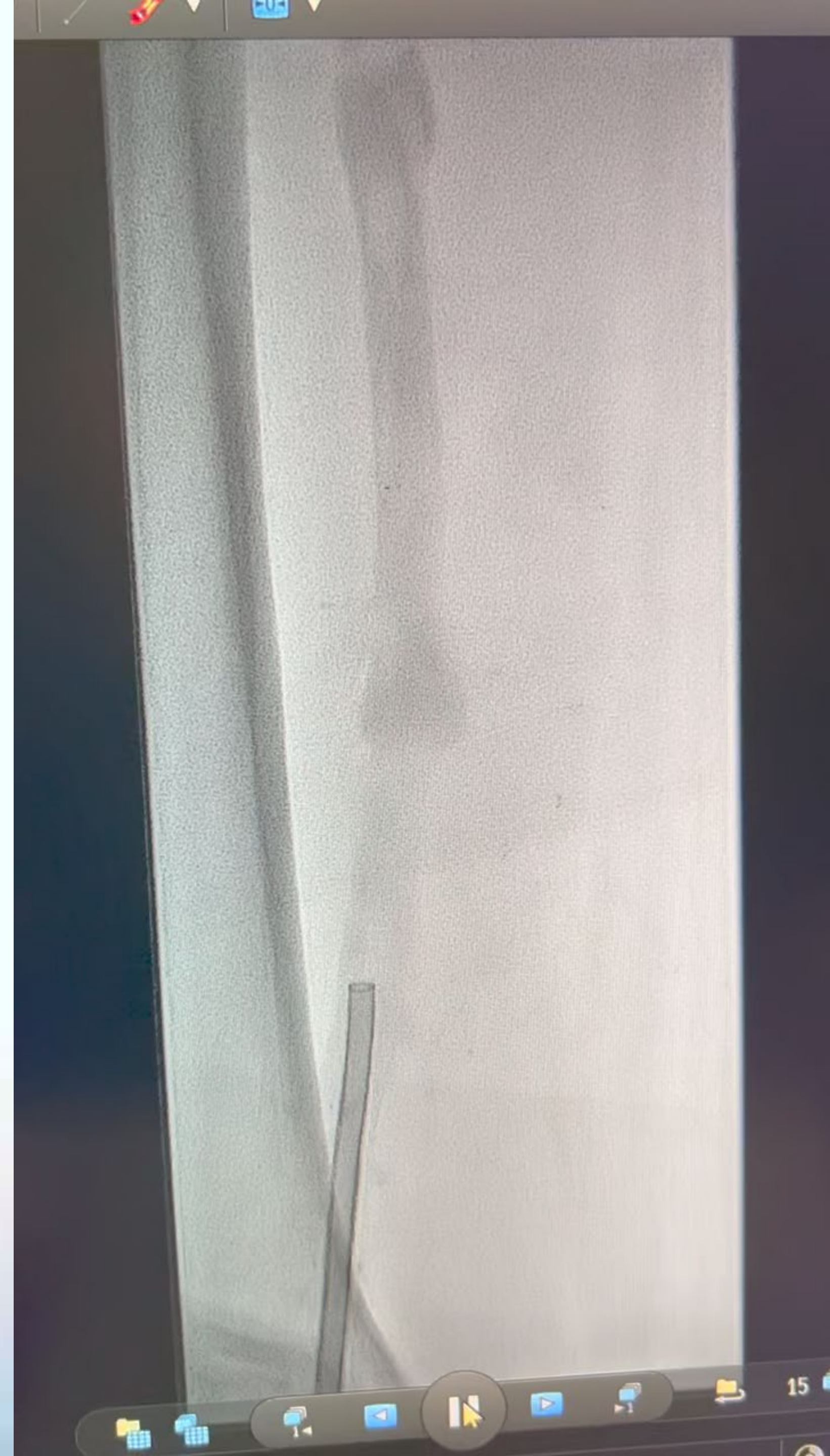
- Smaller devices that deliver thrombolytic
- Rheolytic will also remove thrombus through suction
- Advantage is lower profile and easier to deliver
- Disadvantage of either long dwelling period of catheter, use of lyrics, and inability to remove large thrombus burden
- Allow more distal access
- Increased number of cath lab procedures

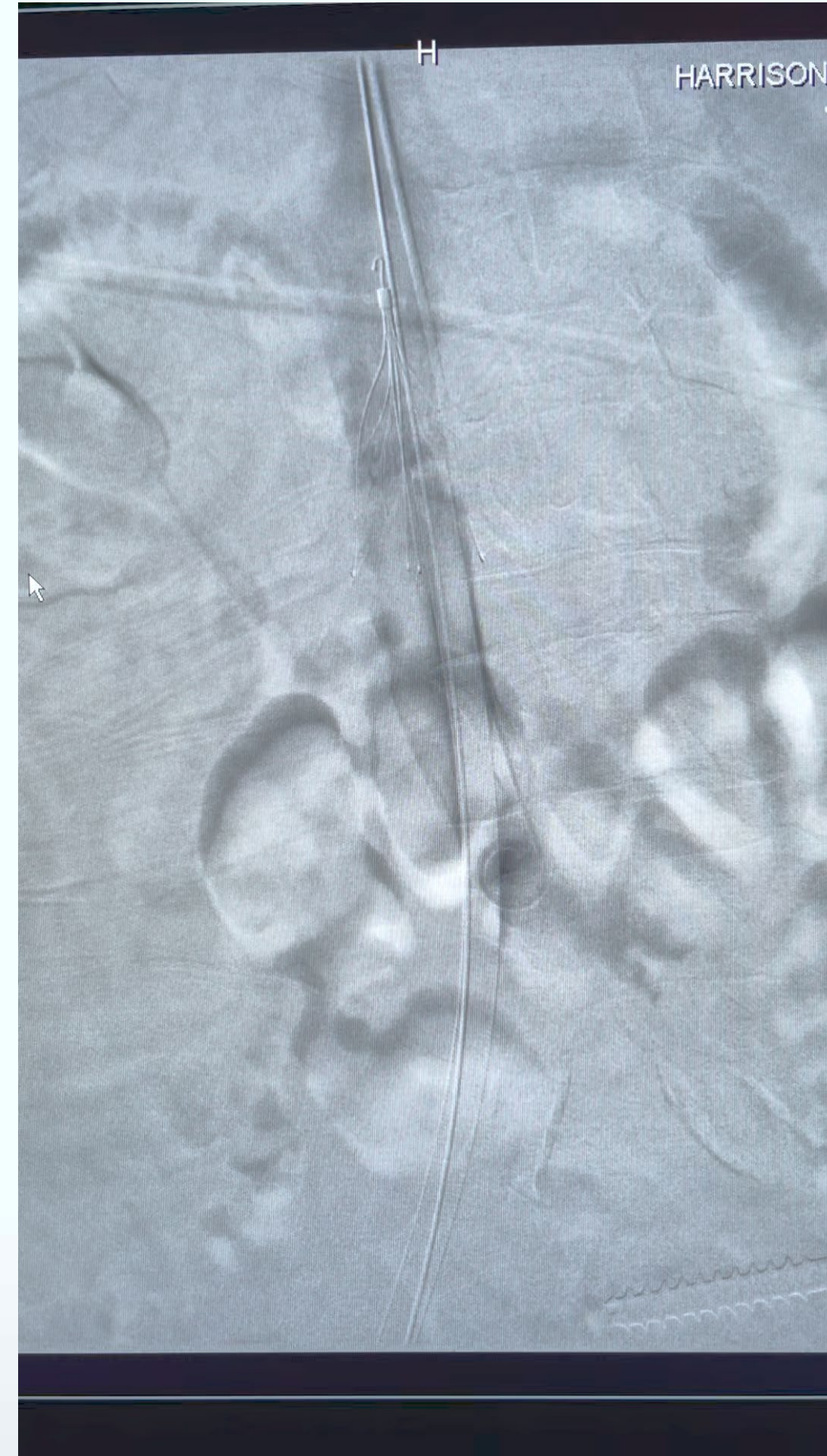
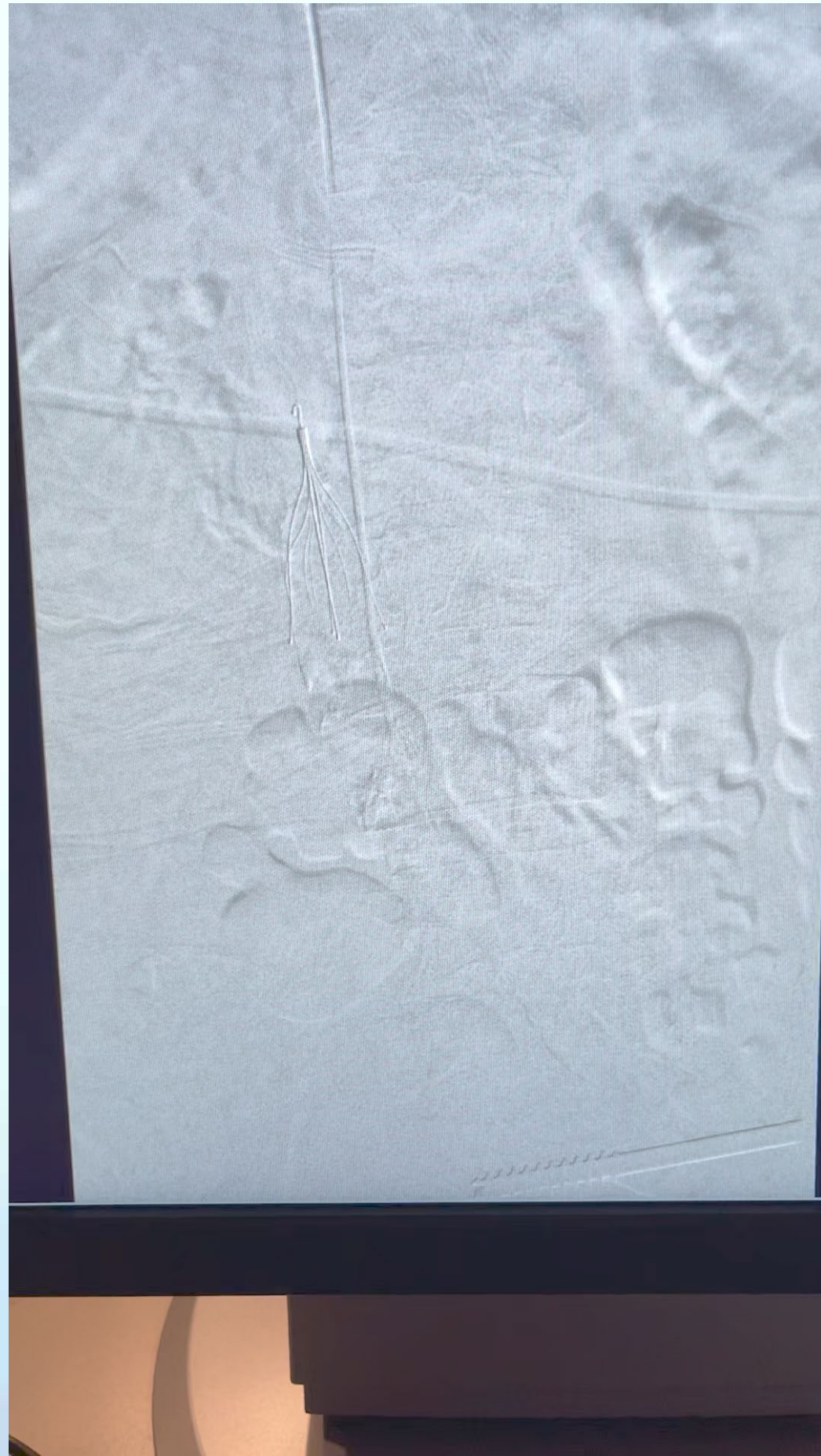
PEARL DVT Trial

- Assessed catheter directed thrombolysis with and without rheolytic thrombectomy
- Groups were all effective in relieving symptoms
- Rheolytic Thrombectomy reduced the amount of thrombolytic utilized
- 97% of vessels demonstrated improvement in thrombus burden

Suction Thrombectomy

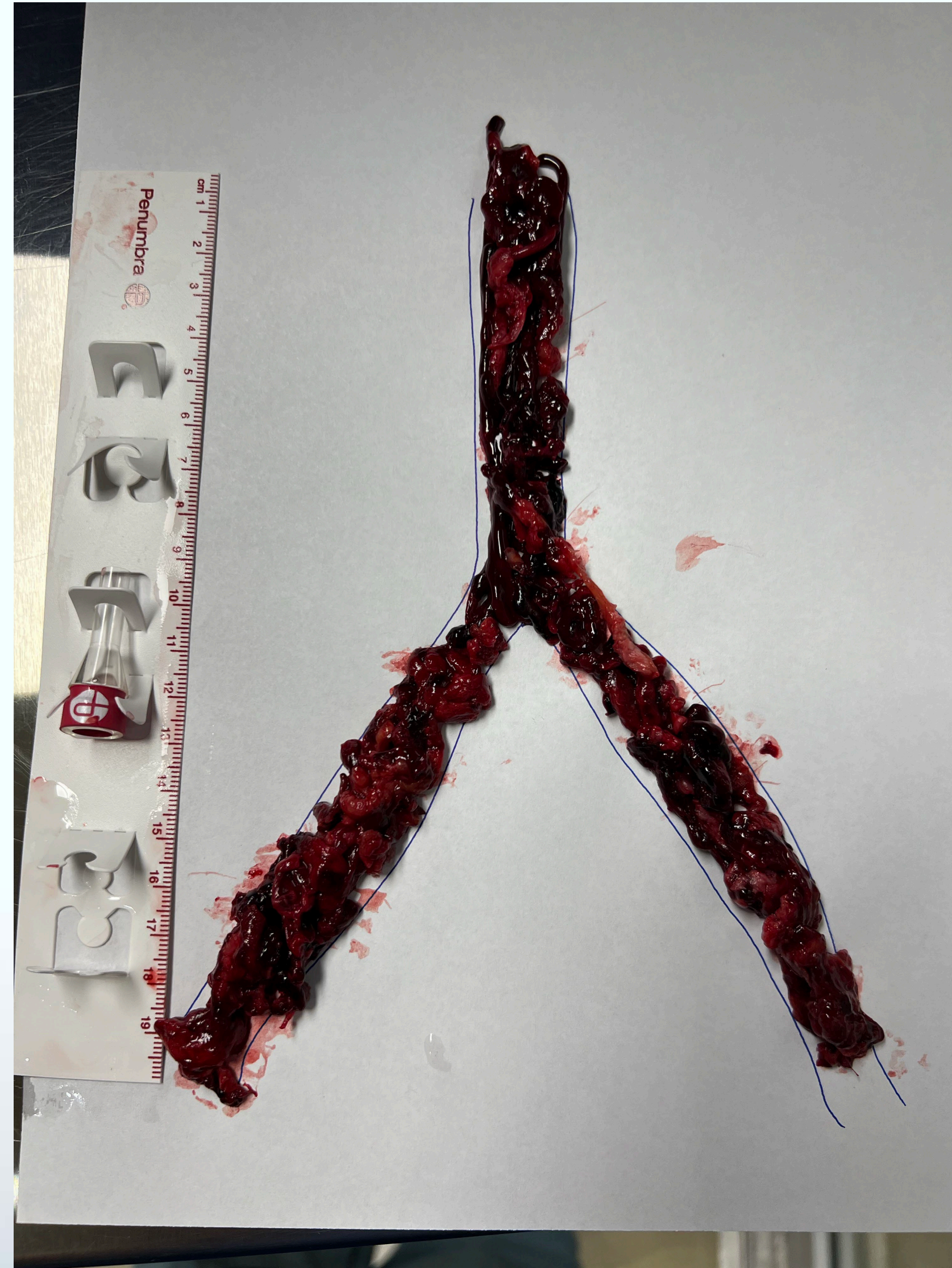
- No thrombolytics
- Typically single session
- Physical removal of clot
- May still struggle with larger clot burden (less issues with current iterations)
- Comparatively more blood loss than alternatives





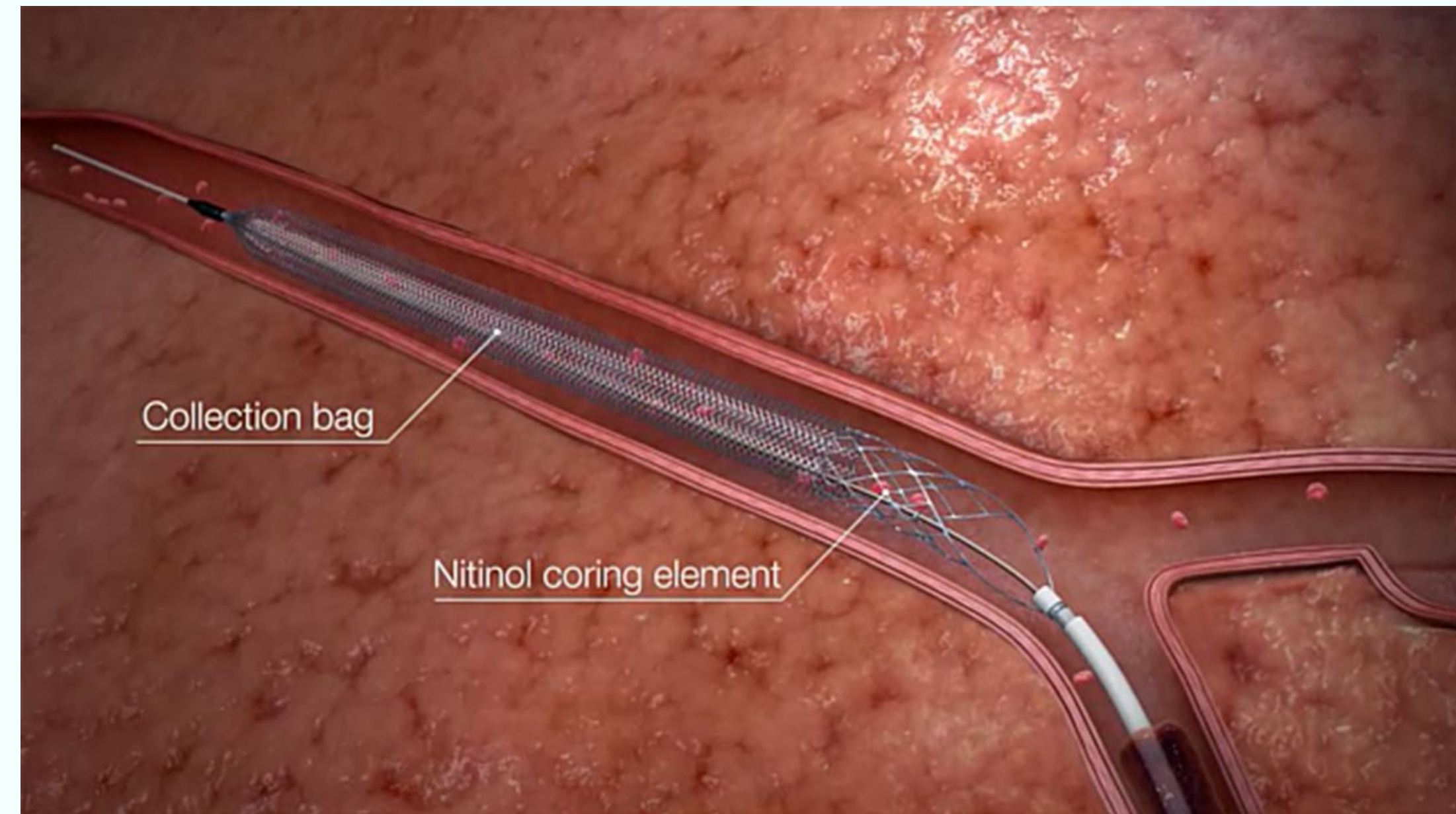
BOLT Trial

- Currently enrolling
- Single arm prospective trial
- Proximal DVT
- Safety and efficacy trial

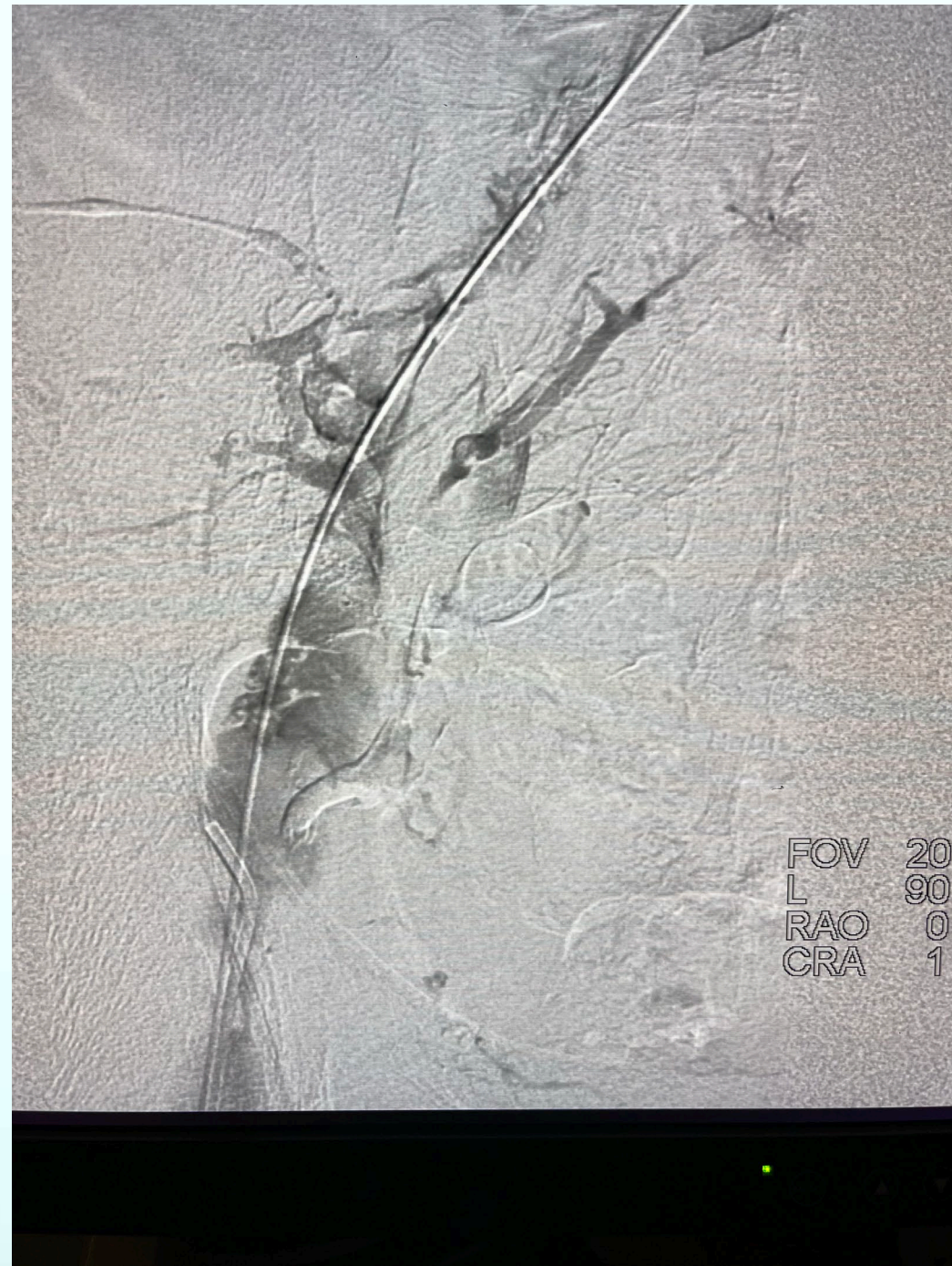


Mechanical Thrombectomy

- No thrombolytic use
- Treats all ages of thrombus (acute, subacute, chronic)
- Removal of large clot burden
- Minimal blood loss
- Single session



Left Lower Extremity DVT



CLOUT Registry

- Mechanical thrombectomy of proximal DVT (iliofemoral)
- Complete removal of thrombus in 85% of patients
- Treatment included all three stages of thrombus
- No reported vessel damage and only 1 device related event
- 91% free of moderate to severe post thrombotic syndrome

DEFIANCE Trial

- Randomized control trial (Clot Triever vs anticoagulation)
- Proximal DVT (iliac or common femoral vein)
- At least moderate symptoms
- 6 month follow up
- Actively enrolling



CONCLUSIONS

- Rapidly evolving area of treatment and intervention
- Data will be lagging behind innovation
- Quickly losing ability to collect meaningful randomized data
- Currently requires patient specific discussion about goals of treatment
- Devices will only become smaller, safer and more effective but will likely extend use into less proficient operators and increase usage

