

Intervention For ***Acute Limb Ischemia***

Jae-Hwan Lee, MD, PhD

Cardiovascular Center in
Chungnam National University Hospital

Catheter-Based Thrombectomy (CBT)

Arterial

- Acute limb ischemia
- STEMI
- Ischemic stroke

Venous

- Deep vein thrombosis
- Pulmonary embolism
- AV fistula occlusion

Rutherford Classification of ALI

Table 1. Stages of Acute Limb Ischemia.*

Stage	Description and Prognosis	Findings	
		Sensory Loss	Muscle Weakness
I	Limb viable, not immediately threatened	None	None
II	Limb threatened		
IIa	Marginally threatened, salvageable if promptly treated	Minimal (toes) or none	None
IIb	Immediately threatened, salvageable with immediate revascularization	More than toes, associated with pain at rest	Mild or moderate
III	Limb irreversibly damaged, major tissue loss or permanent nerve damage inevitable	Profound, anesthetic	Profound, paralysis (rigor)

* Data are from the Society for Vascular Surgery standards.⁴

Diagnosis and Treatment Algorithm

A Diagnosis

Symptoms

Pain
Paresthesia
Weakness or paralysis

Signs

Absent pulses
Pallor
Cool skin
Decreased sensation
Decreased strength
Limb blood pressure <50 mm Hg

Potential Causes

Thrombosis of artery
or bypass graft
Embolism from heart
or proximal vessel
Dissection
Trauma

B Management

Initial treatment with intravenous heparin

Imaging and treatment according to severity

Stage I

Viable limb
Not immediately threatened

Imaging

Stage IIa

Marginally threatened

Imaging

Stage IIb

Immediately threatened

Imaging if no delay in
emergency revascularization

Stage III

Irreversible damage

Indication of CBT

- **Mild-to-moderate limb ischemia (stage I & IIA)**
 - viable or marginally threatened limb
- **Recent occlusion \leq 2 weeks**
- **Thrombosis of a synthetic graft**
- **Acute stent occlusion**
- **At least one identifiable distal runoff**

- **Not accessible to embolectomy**
- **Popliteal artery aneurysm where all run-off vessels are also thrombosed**
- **When surgery deemed too high a risk**

N Engl J Med 2012;366:2198-206

J Vasc Surg. 2007;45(1 Suppl):S5-S67

CBT; UK vs. tPA?

- tPA; (half-life 5 min)
 - Bolus injection of 5-10 mg t-PA
 - Continuous infusion of 0.5-1.5 mg/hr
- UK; (half-life 20 min)
 - Bolus injection of a 250,000 U
 - Followed by 4000 U/min for 4 hours
 - Followed by 2000 U/min for up to 32 hours
- *in a volume >100 ml/hr*
- *coupled with peripheral or intrasheath IV heparin at 600-800 U/h*

Tech Vasc Interventional Rad 2009;12:117-29

- My center; keeping UK 1,000,000 U in the cath lab

Ann Surg 1994;220:251-66

- 200,000 U for intralesional injection during the procedure

→ Overnight UK infusion, 800,000 – 1,000,000 U in 1 L N/S

mix IV for the next 10-15 hrs, 70-100 cc/hr speed, UK dose \cong 60,000~80,000 U/hr

ALI; Endovascular Thrombus Management

Thrombolysis

- Catheter-directed thrombolysis (CDT)

Mechanical Adjuncts

- Manual aspiration thrombectomy (MAT) – Sheath / Catheter
- Mechanical fragmentation – Rotarex, Jetstream
- Rheolytic thrombectomy – Angiojet
- Aspiration thrombectomy
 - Aspirex, ThromCat, Indigo, Megavac
- Ultrasonic / Laser

Manual vs. Mechanical Thrombectomy

Catheter Aspiration Thrombectomy:
Syringe suction used to aspirate the debris



Mechanical Thrombectomy: Saline jets or rotating catheter head to breakup thrombus before its aspiration



Manual Devices include: Diver™, Diver™ CE, Export®, Pronto™, QuickCat, Rescue™, Thrombuster®, and TransVascular Aspiration Catheter®.

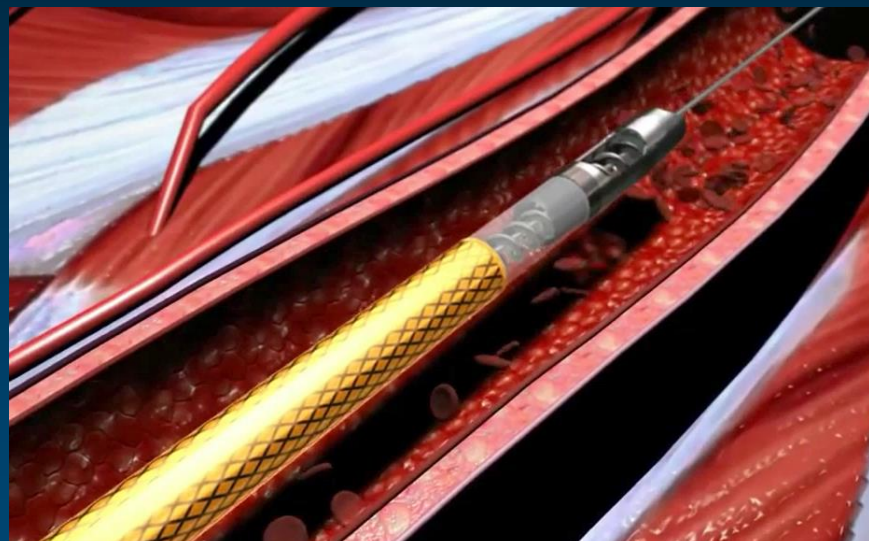
Mechanical devices include: AngioJet® (and X-Sizer®.)

Mechanical Devices for Thrombus Removal

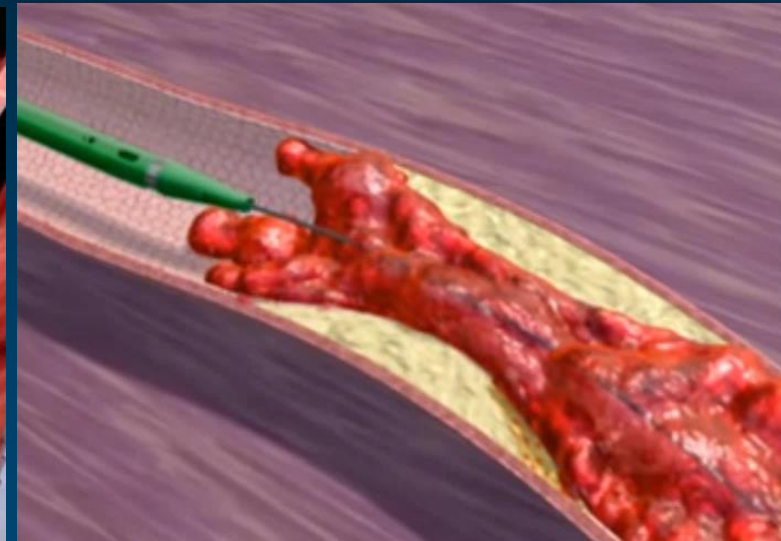
Now available in Korea



Jetstream, BSC



Rotarex, Straub Medical



Angiojet, BSC

**Most Simple & Cheap Way;
*Thrombosuction by a sheath***



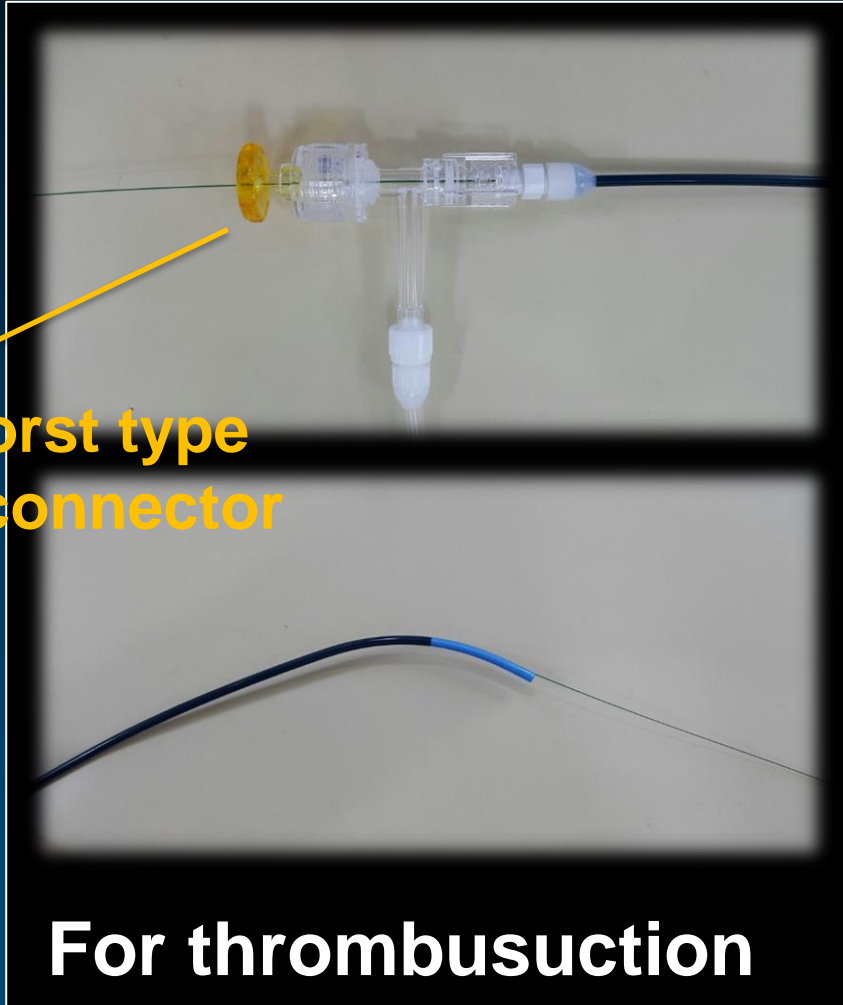
Most Simple & Cheap Way;
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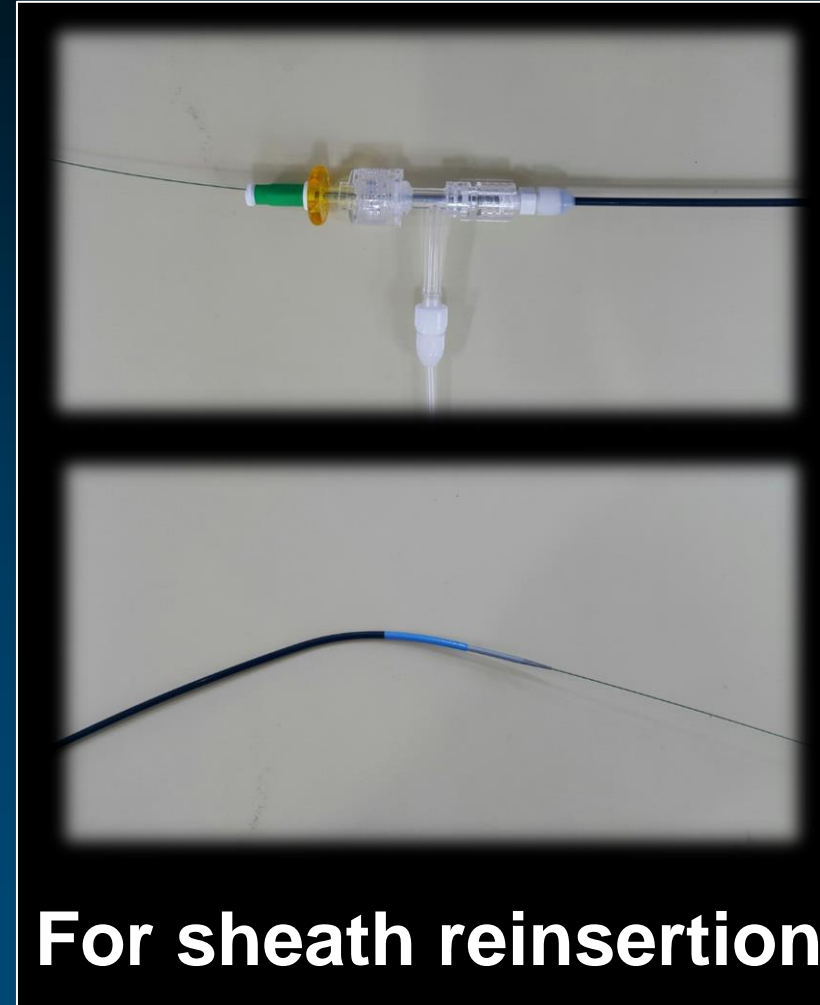
My Aspiration Devices

Ipsilateral approach;

Ansel sheath + Sheath dilator + 0.014" Command ES GW



For thrombusuction



For sheath reinsertion

Contralateral approach;

Shuttle sheath + 0.035" compatible Dilator + 0.035" Amplatzer extrastiff GW

My Personal Aspiration Devices

Iliac

- Ipsilateral or Contralateral
- 7 Fr Ansel sheath + Sheath dilator + 0.014" Command ES GW

Femoral

- Ipsilateral; 7 Fr Ansel sheath + Sheath dilator + 0.014" Command ES GW
- Contralateral; 6-7 Fr Shuttle sheath + Sheath dilator
 - + 0.014" Command ES GW → for soft aortoiliac anatomy
 - + 0.035" Amplatzer extrastiff GW → for difficult aortoiliac anatomy

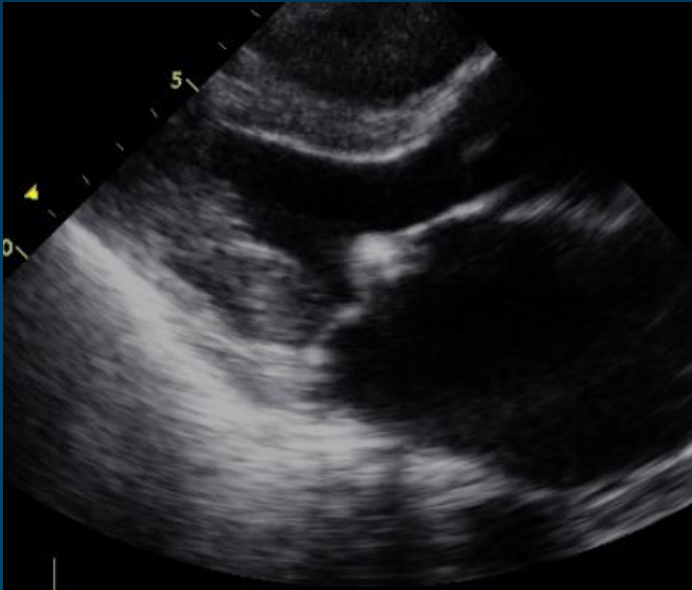
Proximal BTK; 5 Fr Heartrail through the Ansel / Shuttle sheath

Foot level; Thrombuster or Export catheter

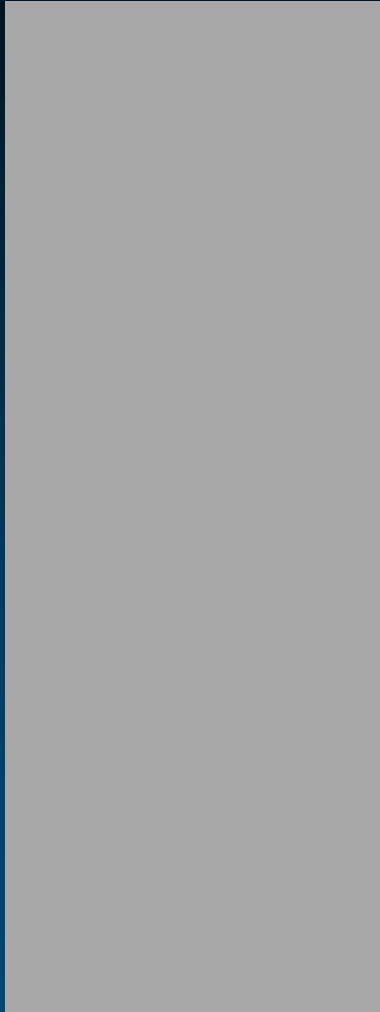
Representative Cases

Case

- 61 / F, ALI Rutherford I
- Slowly progressing dyspnea, NYHA Fc 3
- Right leg pain, coldness and numbness for 2 weeks
- ECG; Afib
- TTE; Severe MS, MVA 0.9 cm², LAA thrombi



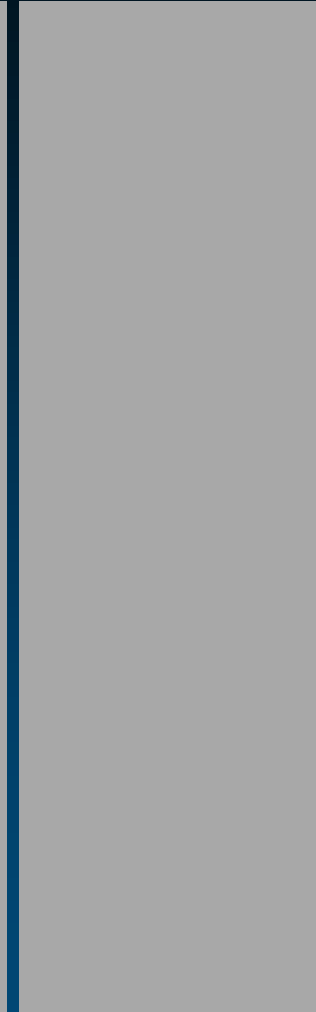
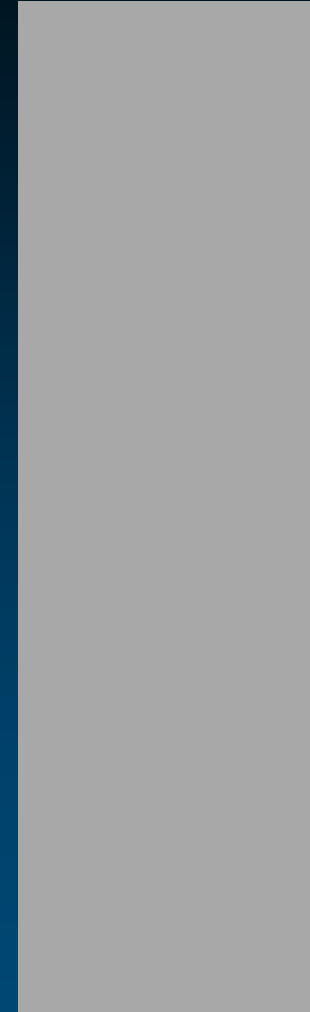
Right popliteal embolic occlusion



Baseline



Aspiration with 7Fr sheath

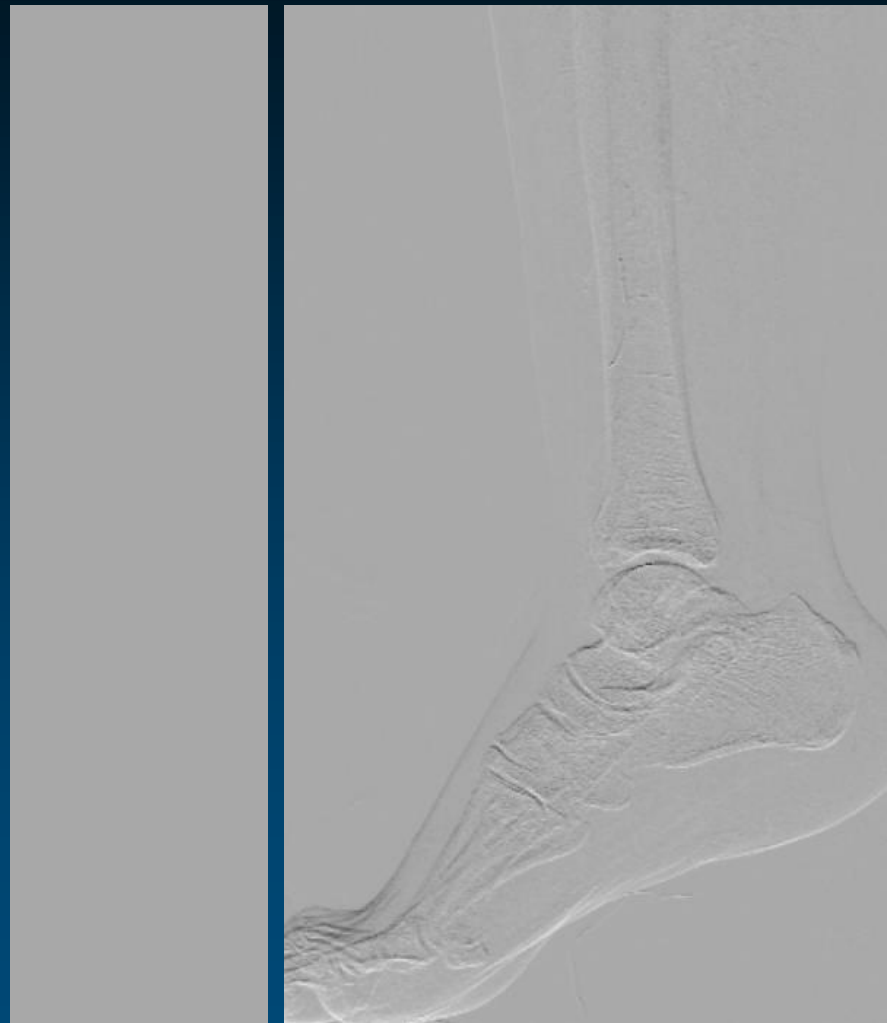


**Angiogram using
suction catheter**

Thrombectomy using both sheath and suction catheter



Sheath aspiration for P3

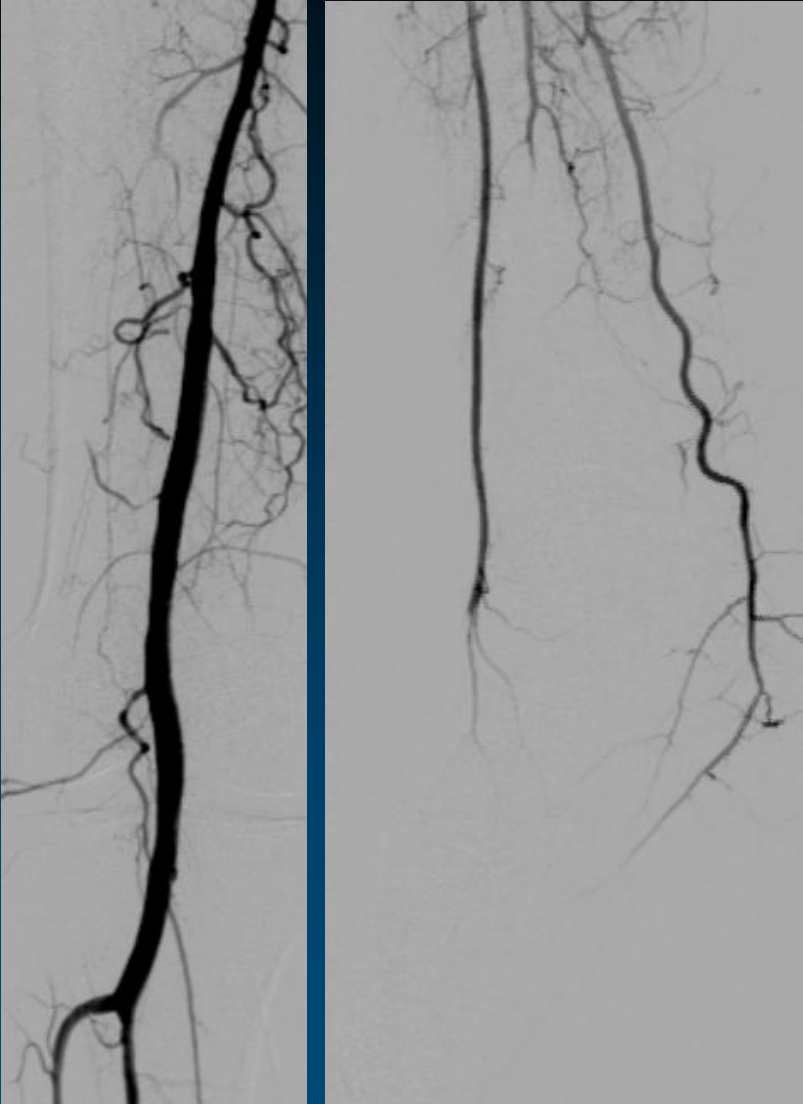


Final angiogram of the 1st procedure

Thrombus on the table



After overnight UK infusion, 100,000U/hr

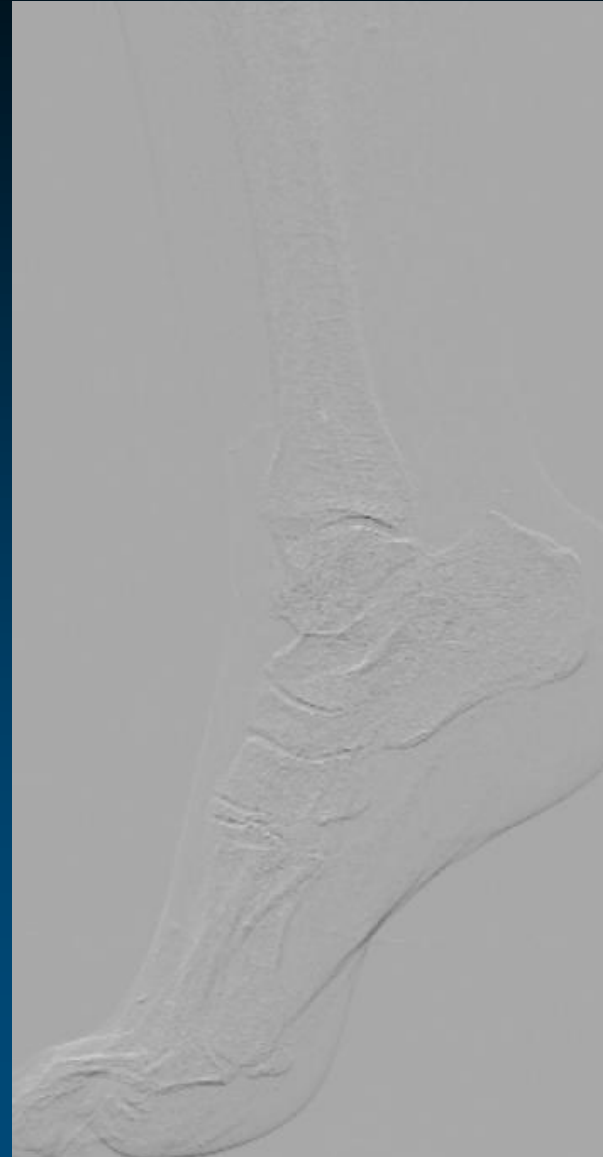


Next day angiogram



Suction and balloon angioplasty

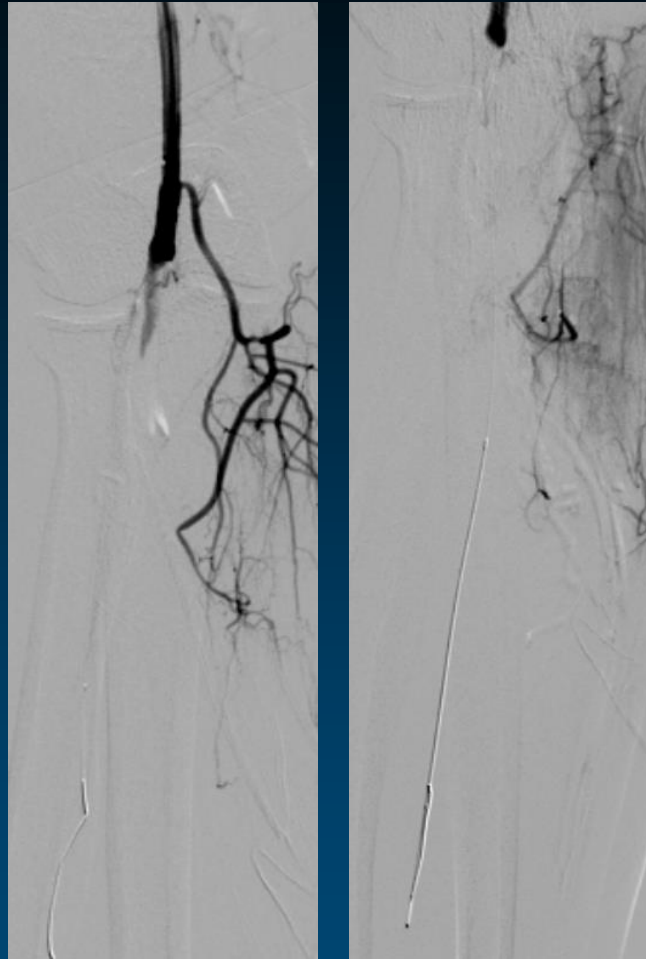
Final angiogram



Case

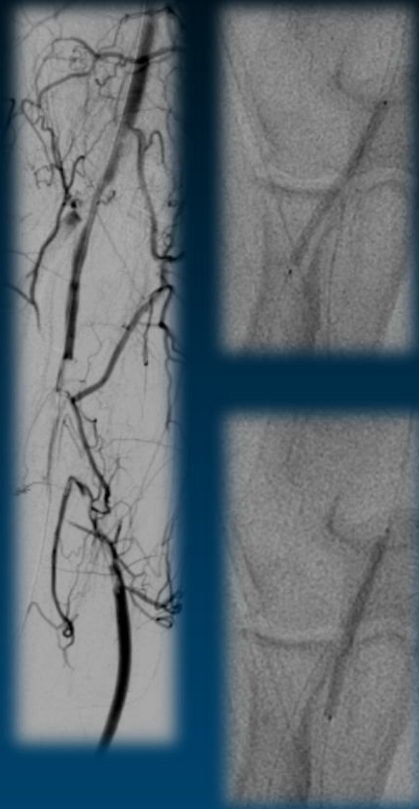
- ◎ 41 / F, Antiphospholipid syndrome with arm embolism
- ◎ Smoker
- ◎ Right hand color change, coldness and pain for 3 weeks
- ◎ Poor right ulnar and radial pulsation
- ◎ Normal left U/E and both L/E angiogram
 - Ruled out Buerger's disease
- ◎ Lupus anticoagulant Ab (+)

Brachial artery embolic occlusion



**Femoral approach
5 Fr 110 cm long Shuttle sheath
0.014" Command GW
Thrombuster catheter**

After overnight UK infusion



Repeated aspiration thrombectomy +
Kissing balloon angioplasty

Case

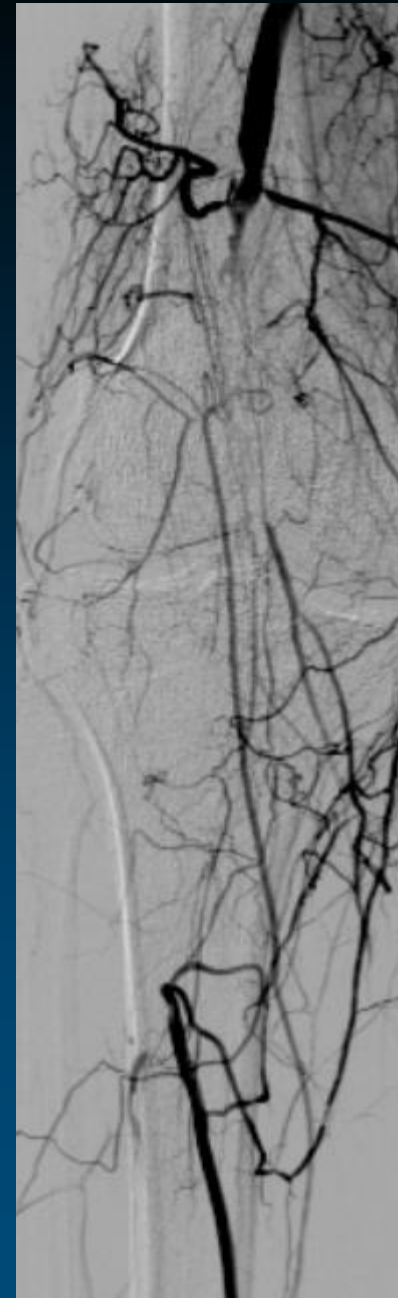
- 75 / M, ALI, Rutherford IIa
- H/O CHF with pulmonary edema, 2010
 - severe LV dysfunction, EF 28% with LAA thrombi
 - F/U Lost
 - Right lower leg pain for 5 days
- Atrial fibrillation



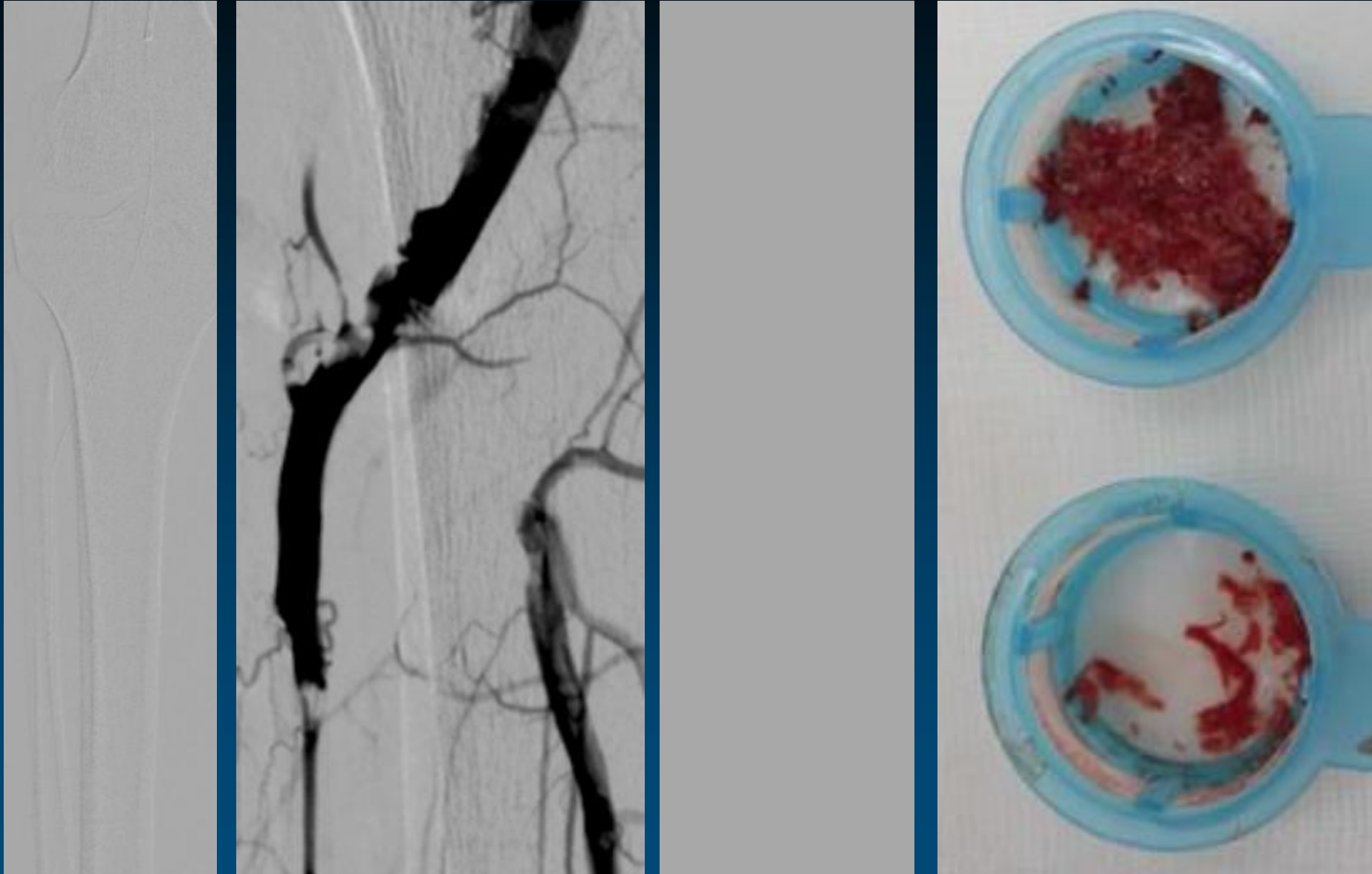
CT angiogram



Angiogram



Thrombus aspiration from Popliteal, ATA and PTA



Ipsilateral antegrade 7 Fr Ansel sheath

***Overnight intralésional UK infusion
→ Followed by adjunctive balloon angioplasty***



Case of Mechanical Thrombectomy

ALI case with toe gangrene - subacute course

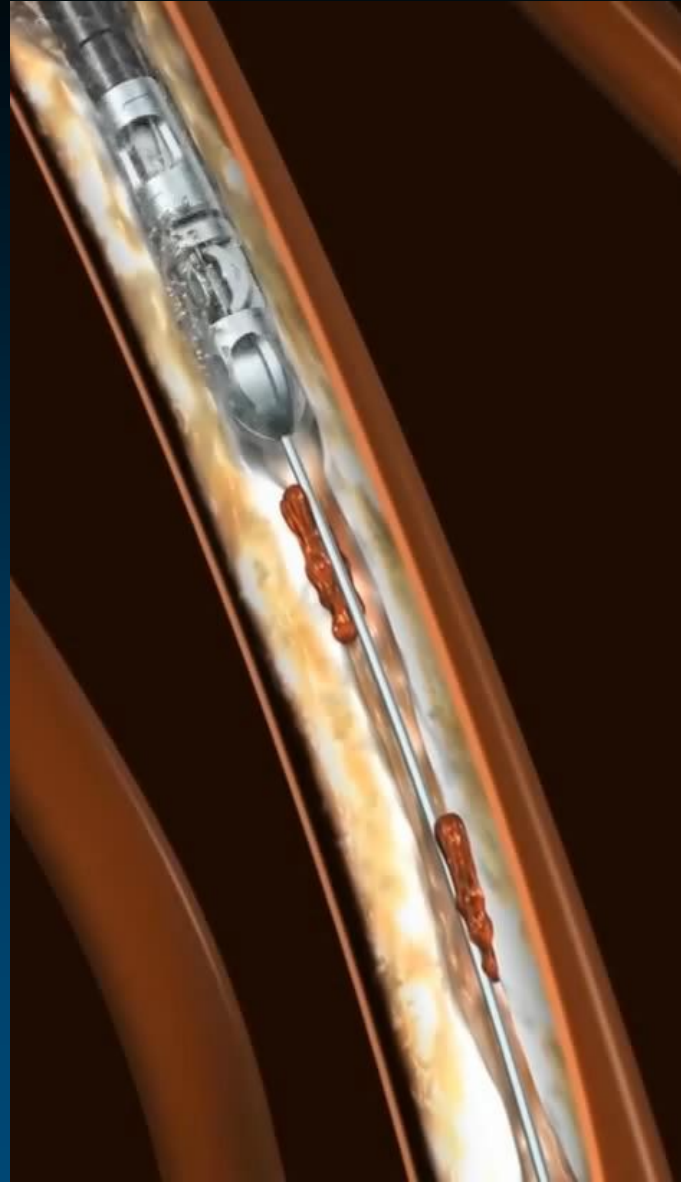
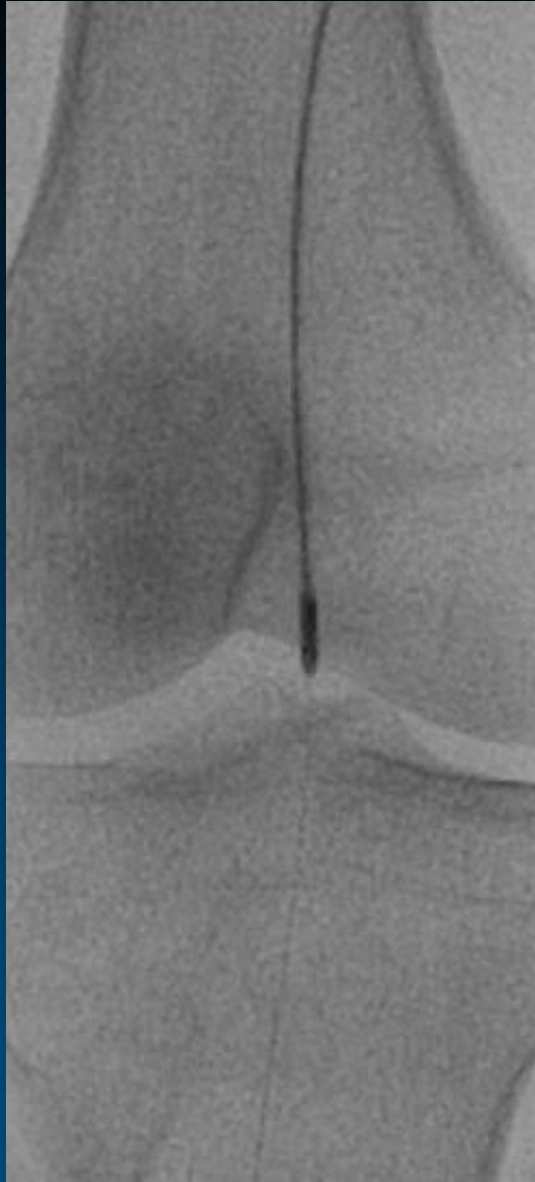
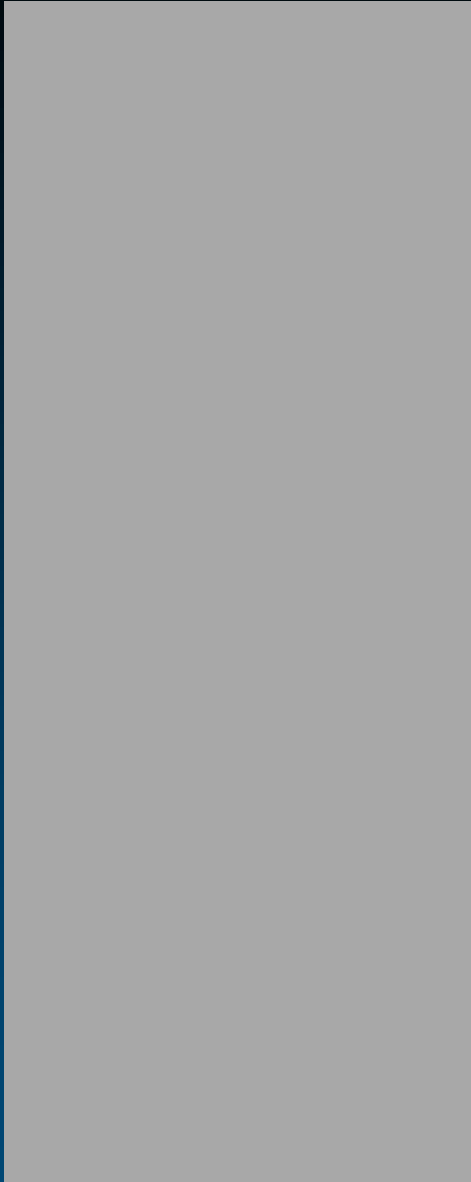
46/M

Polycythemia vera

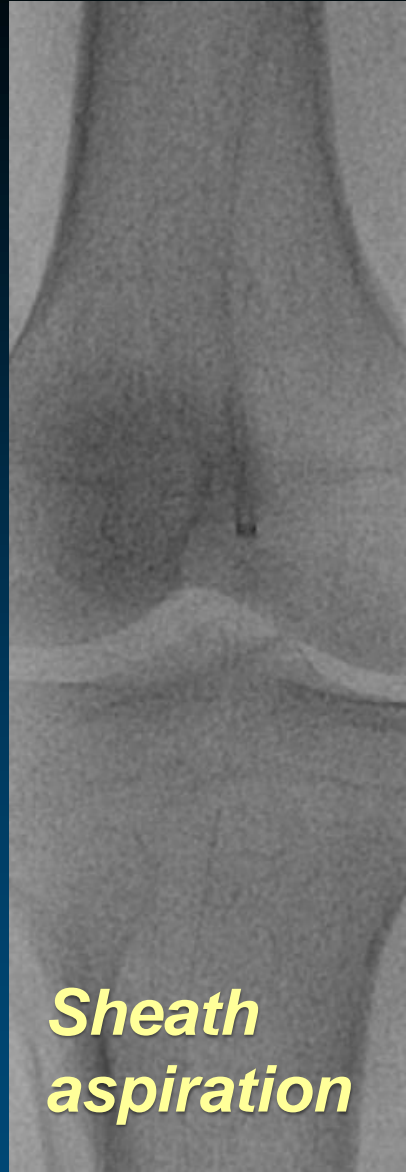
Hb 20.5g/dL, WBC 20,500/uL, PLT 512K/uL

Right calf pain, coldness and 1st toe gangrene for 1 month





Jetstream thrombectomy



*Sheath
aspiration*

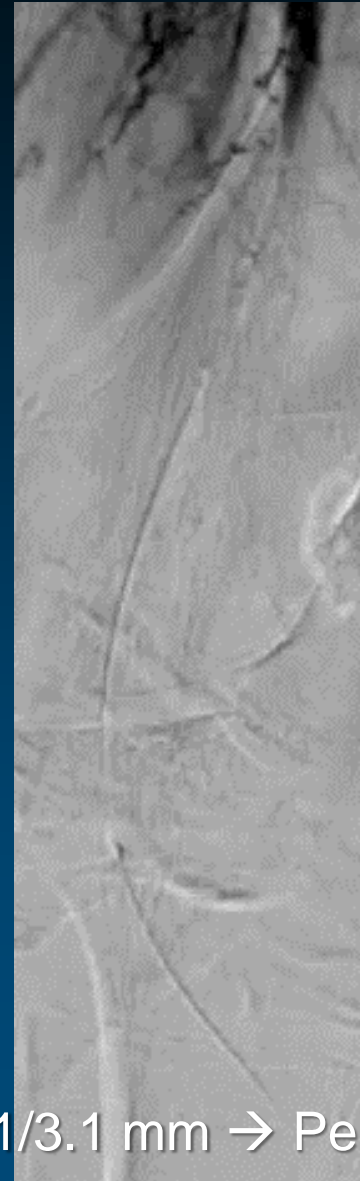


DEB 6.0x120 mm

74/F, ALI stage IIa, 10 days ago onset

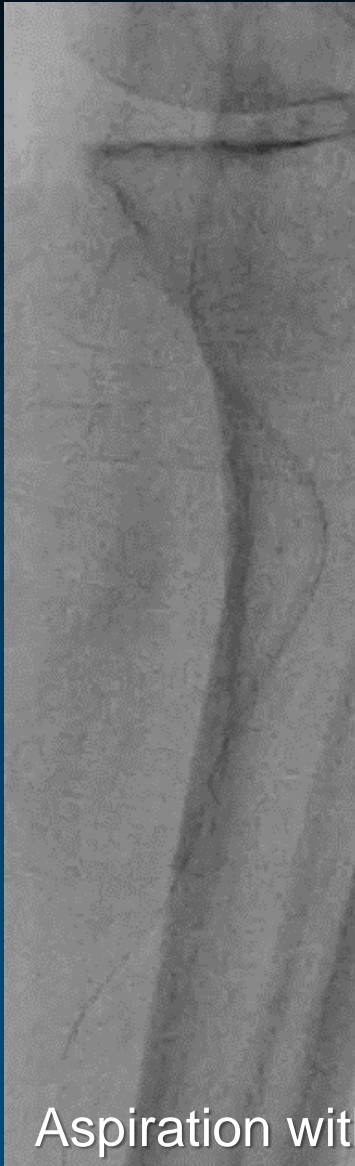


Right popliteal occlusion

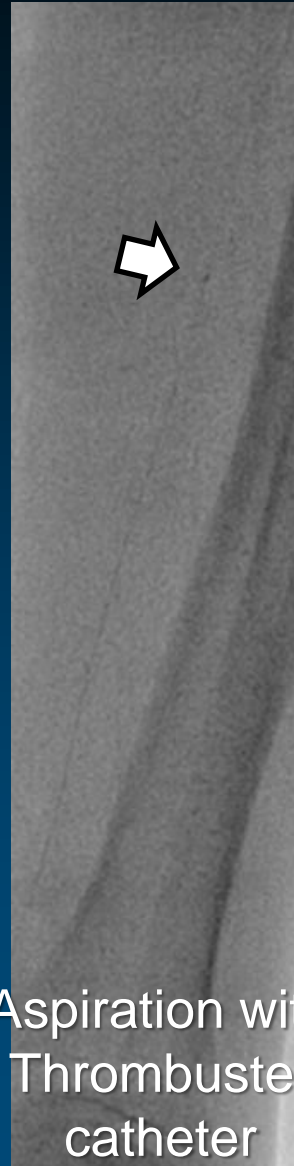


Jetstream 2.1/3.1 mm → Perforation → Prolonged balloon

74/F, ALI stage IIa, 10 days ago onset



Aspiration with 5 Fr Heartrail



Aspiration with Thrombuster catheter



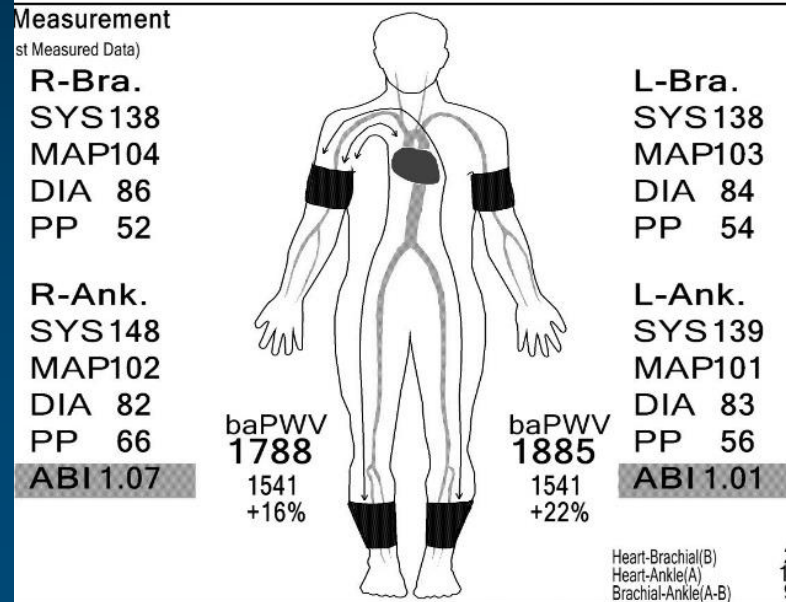
Balloon angioplasty



74/F, ALI stage IIa, 10 days ago onset



Final angiogram



6 months later, asymptomatic, but

ALI CBT Data From Our Center - Baseline

	Total (n=57)	Manual Aspiration (n=38)	Jetstream (n=19)	P-value
Age	72.4±13.6	68.1±12.9	81.2±10.5	<0.001
Sex(male)	40(70.2%)	28(73.7%)	12(63.2%)	0.407
DM	27(47.4%)	20(52.6%)	7(36.8%)	0.260
IHD	28(49.1%)	21(55.3%)	7(36.8%)	0.190
Previous CI	12(21.1%)	9(23.7%)	3(15.8%)	0.491
CKD	14(24.6%)	6(15.8%)	8(42.1%)	0.030
HTN	38(66.7%)	25(65.8%)	13(68.4%)	0.843
Dyslipidemia	9(15.8%)	8(21.1%)	1(5.3%)	0.123
AF	20(35.1%)	13(34.2%)	7(36.8%)	0.844
Cancer	11(19.3%)	7(18.4%)	4(21.1%)	0.812
Smoking	17(25.5%)	12(31.6%)	5(26.3%)	0.682

Retrospective Analysis, not published

ALI CBT Data From Our Center – Presentation & Lesion

	Total (n=57)	Manual Aspiration (n=38)	Jetstream (n=19)	P-value
Sx duration (day)	22.4±28.2	25.4±32.4	16.3±16.4	0.257
Onset of Sx				
Acute (<14day)	36(63.2%)	25(65.8%)	11(57.9%)	0.560
Subacute (>2wk)	21(36.8%)	13(34.2%)	8(42.1%)	0.560
Rutherford grade				
I	34(59.6%)	25(65.8%)	9(47.4%)	0.181
IIa	11(19.3%)	8(21.1%)	3(15.8%)	0.635
IIb	12(21.1%)	5(13.2%)	7(36.8%)	0.039
Proximal extent				
Iliac	10(17.5%)	7(18.4%)	3(15.8%)	0.805
Femoral	29(50.9%)	13(34.2%)	16(84.2%)	<0.001
Popliteal	11(19.3%)	11(28.9%)	0(0.0%)	0.009
Tibial	7(12.3%)	7(18.4%)	0(0.0%)	0.046

Retrospective Analysis, not published

ALI Data From Our Center – Procedural Characteristics

	Total (n=57)	Manual Aspiration (n=38)	Jetstream (n=19)	P-value
Sheath diameter(Fr)	6.28±0.84	5.92±0.82	7.00±0.0	<0.001
Lesion length(mm)	156.2±85.4	132.7±77.7	203.3±82.4	0.002
Calcification				
No/mild	43(75.4%)	28(73.7%)	15(78.9%)	0.663
Moderate	13(22.8%)	9(23.7%)	4(21.1%)	0.823
Severe	1(1.8%)	1(2.6%)	0(0.0%)	0.476
Intervention feature				
De novo lesion	47(82.5%)	21(81.6%)	16(84.2%)	0.805
Previous PTA lesion	19(17.5%)	7(18.4%)	3(15.8%)	0.805

ALI Data From Our Center – Procedural Characteristics

	Total (n=57)	Manual Aspiration (n=38)	Jetstream (n=19)	P-value
UK use	47(82.5%)	32(84.2%)	15(78.9%)	0.622
UK dose(10thousand)	53.2±39.1	56.3±39.6	46.8±38.2	0.393
UK duration(hour)	6.2±5.1	6.6±4.8	5.3±5.6	0.389
Initial procedure time(min)	97.5±39.3	87.8±38.7	118.8±32.2	0.003
Initial radiation time min)	39.8±20.2	32.9±16.4	53.7±20.2	<0.001
Initial contrast dose(cc)	160.8±64.9	147.9±67.6	186.6±51.3	0.032
Stage procedure	22(38.6%)	19(50.0%)	3(15.8%)	0.012
Stage procedure time(min)	32.8±53.3	38.7±49.9	21.1±59.1	0.242
Stage radiation time(min)	13.7±18.5	17.1±19.0	7.0±16.1	0.052
Stage contrast dose(cc)	53.1±65.9	64.5±69.1	30.4±53.7	0.065
Total procedure time(min)	128.7±67.8	123.1±69.0	139.9±65.9	0.382
Total radiation time(min)	53.5±24.5	50.0±24.1	60.7±24.2	0.120
Total contrast dose(cc)	213.4±81.9	211.6±89.1	217.0±67.5	0.817
Costs (1,000 won)	10578.0±5366.8	10605.7±5632.7	10552.6±4938.3	0.972
Hospital stay(day)	22.6±39.6	30.4±46.5	7.05±6.1	0.034

Retrospective Analysis, not published

ALI Data From Our Center – Procedural Complications

	Total (n=57)	Manual Aspiration (n=38)	Jetstream (n=19)	P-value
Transient embolism	42(72.3%)	26(68.4%)	16(84.2%)	0.202
Embolism	7(12.3%)	3(7.9%)	4(21.1%)	0.154
Hematoma	3(5.3%)	3(7.9%)	0(0.0%)	0.208
Bleeding	4(7.0%)	4(10.5%)	0(0.0%)	0.142
Respiratory distress	1(1.8%)	1(2.6%)	0(0.0%)	0.476
Dissection or perforation	2(3.5%)	0(0.0%)	2(10.5%)	0.042
Deep vein thrombus	0(0.0%)	0(0.0%)	0(0.0%)	1.000
Pseudoaneurysm	1(1.8%)	1(2.6%)	0(0.0%)	0.476
Acute renal failure	2(3.5%)	2(5.3%)	0(0.0%)	0.309
Infection	1(1.8%)	1(2.6%)	0(0.0%)	0.476
Mortality	3(5.3%)	3(7.9%)	0(0.0%)	0.208

ALI Data From Our Center – Clinical Outcomes

	Total (n=57)	Manual Aspiration (n=38)	Jetstream (n=19)	P-value
Procedure failure	3(5.3%)	3(7.9%)	0(0.0%)	0.208
Pre TIMI	0.11±0.36	0.16±0.44	0.0±0.00	0.122
Post TIMI	2.56±0.68	2.53±0.73	2.63±0.60	0.587
Intervention treatment				
Balloon angioplasty	52(91.2%)	34(89.5%)	18(94.7%)	0.508
Stent implantation	6(10.5%)	5(13.2%)	1(5.3%)	0.360
30 day primary patency	49(86.0%)	32(84.2%)	17(89.5%)	0.590
1 year primary patency	42(73.7%)	28(73.7%)	14(73.7%)	1.000
Re-intervention	9(15.8%)	5(13.2%)	4(21.1%)	0.370
Time to 1 st re-intervention	10.7±33.6	8.5±31.7	15.0±37.7	0.441
Amputation	6(10.6%)	5(13.2%)	1(5.3%)	0.360
Limb salvage	53(93.0%)	35(92.1%)	18(94.7%)	0.714

Manual Aspiration vs. Mechanical Thrombectomy

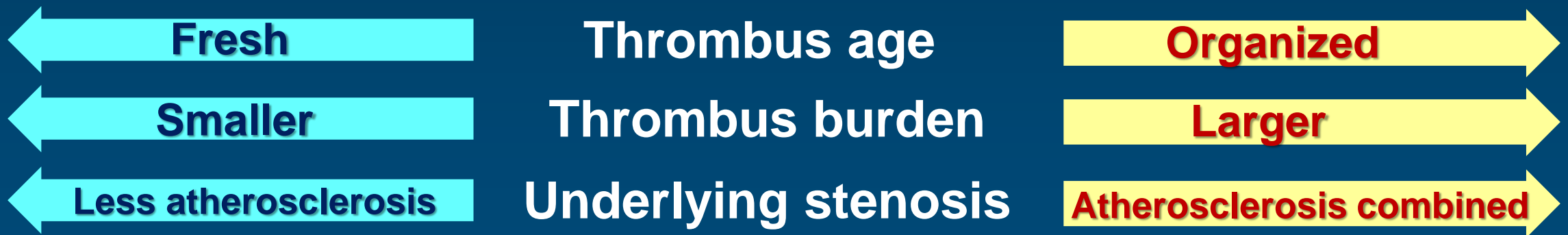
	Manual Aspiration Thrombectomy	Mechanical Thrombectomy
Pros	<p>Less invasive, Cheaper No special device needed Smaller catheter applicable Less time consuming Smaller radiation & contrast dose</p>	<p>More efficient thrombus removal → reduce duration and amount of thrombolytic agents Rapid reperfusion More effective on organized thrombi or combined atherosclerosis</p>
Cons	<p>Less effective thrombus removal More thrombolytic agent needed - longer duration, larger amount - pt's inconvenience, more bleeding risk Repetitive session may be needed</p>	<p>Specialized device should always be prepared in the cath lab → \$2,000 More embolization risk Filter device sometimes needed Potential risk of vessel damage</p>
?	<p>No randomized comparison, No large outcome data → Clinical outcome difference not defined yet Economic burden difference? No answer</p>	

Manual Aspiration vs. Mechanical Thrombectomy

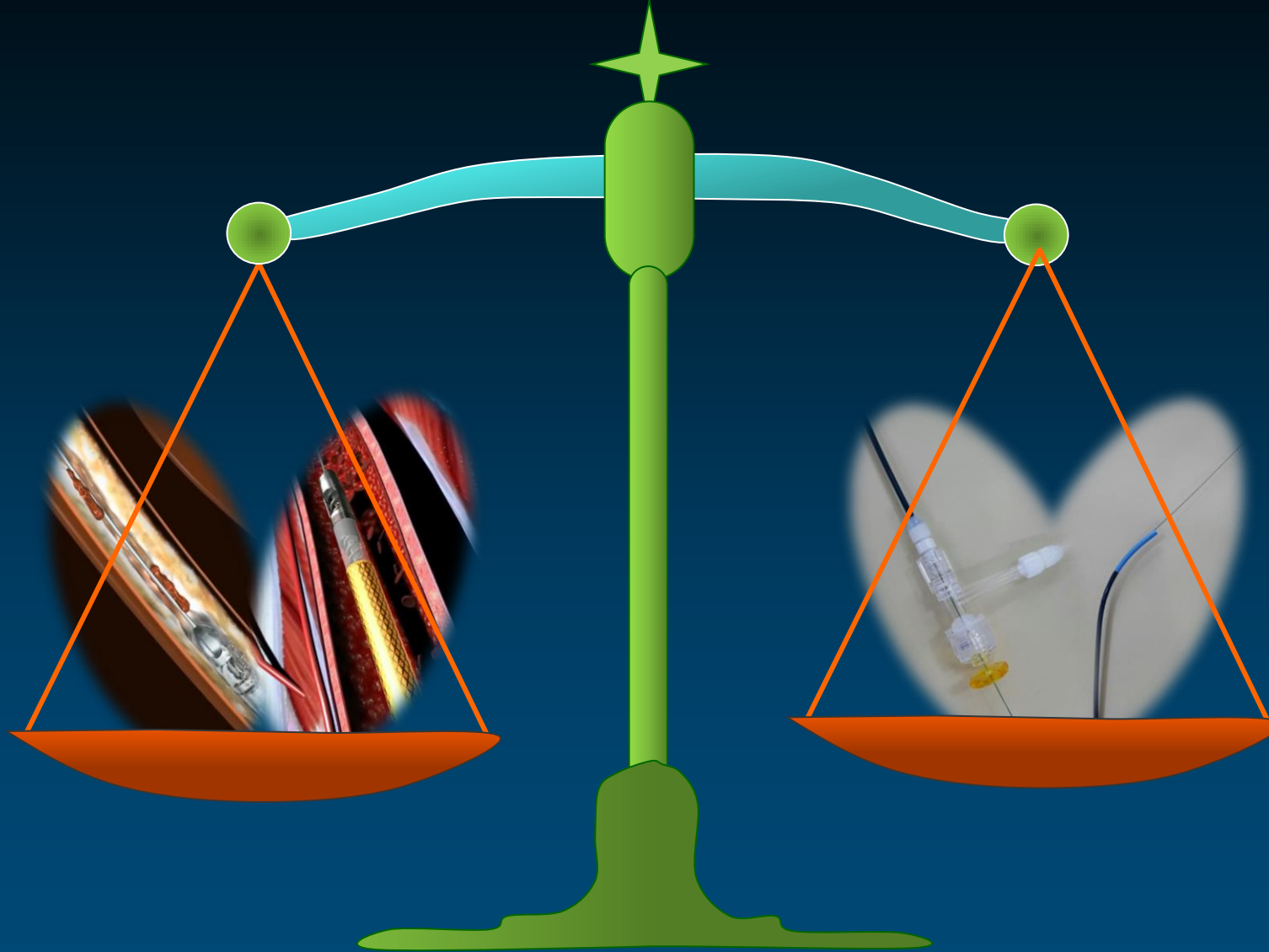
- We definitely need more data.
- Routine use of mechanical device is not desirable.
- We must establish an appropriate treatment strategy based on the patient and the condition of the lesion.

Manual aspiration is usually work

Consider mechanical device



ALI Thrombus - Mechanical vs. Manual?



We must compare the gain and the yarn



For Making Good Footprints

Thanks for the Time

ALI Thrombus - Mechanical vs. Manual?



We must compare the gain and the yarn