Addressing Vascular Access Complications: Best Practices and Innovations

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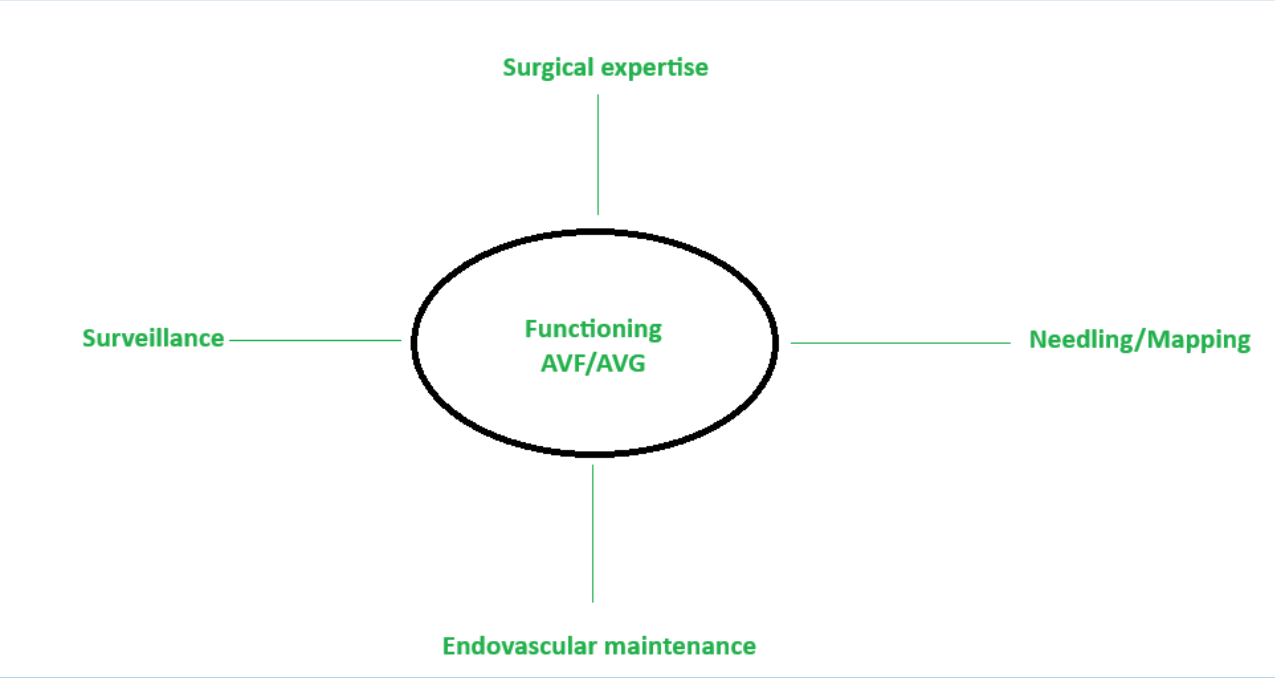
Vascular access complications:



1: Thrombosed fistula

2: Outflow stenosis

3: Inflow stenosis

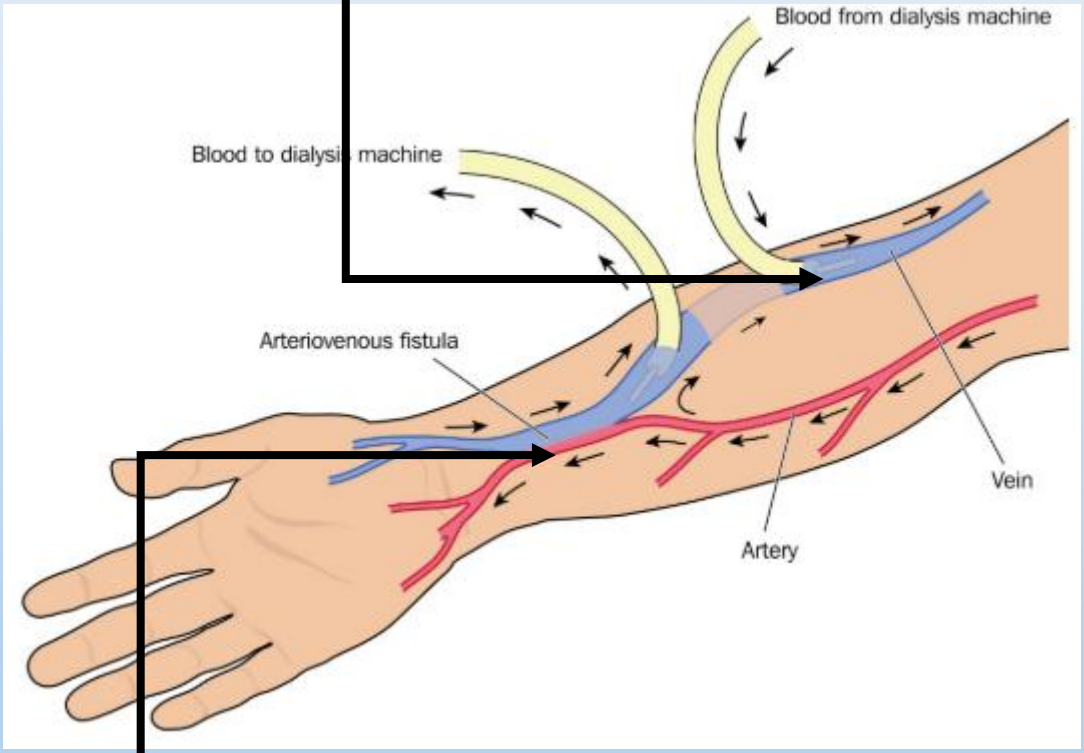
4: Aneurysm formation

*steal syndrome

Clinical examination is key!

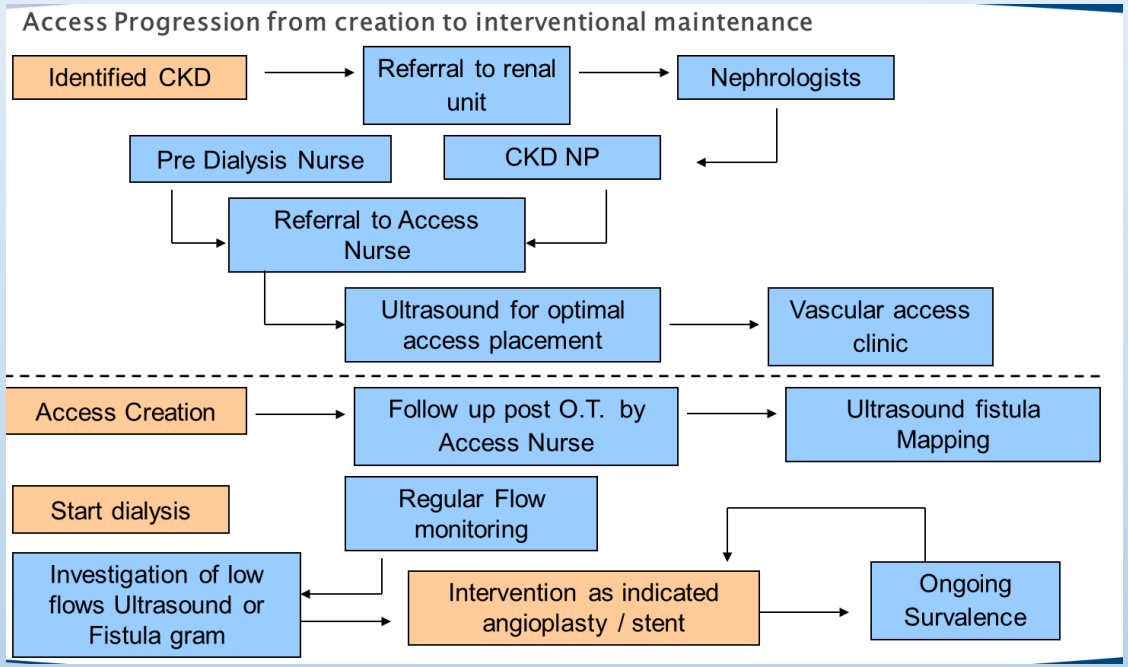
- If the issues are
  - Prolonged bleeding
  - Dilated, torturous vessel
  - High venous pressures
  - Recirculation

- If the issues are
  - Difficulty needling
  - Negative arterial pressures
  - Poor flow rates



Vascular access model of care

- Regular surveillance of fistulas recommended
- Our model of care
  - Nurse led surveillance – physical examination, dialysis parameters, Transonic assessment
  - Education regarding needling practises
  - Escalation to vascular access CNC
  - Booked for intervention most of the time
  - Fistulography and plasty within the same procedure
  - Followup as clinically indicated including routinely for high risk recurrence



Our interventional team

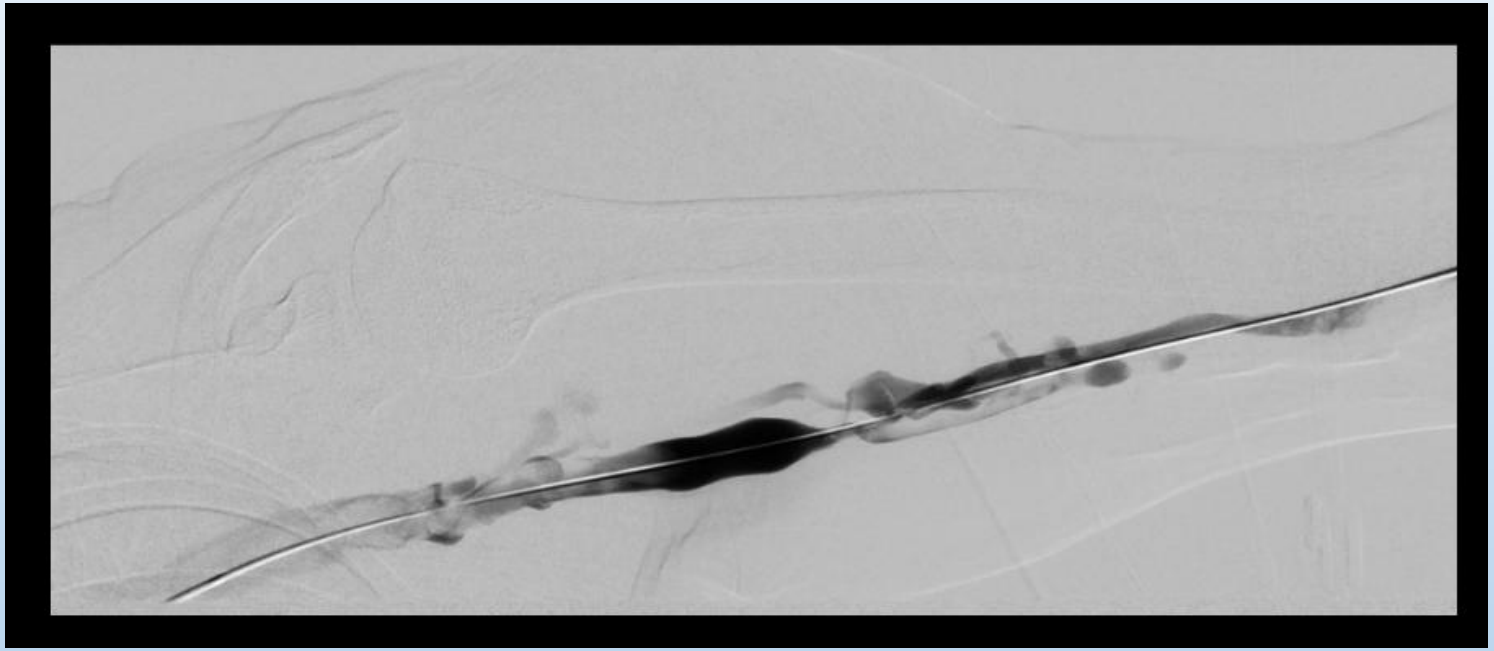
- 350 dialysis patients in the FNQ area
- 2 nephrologists (endovascular) – approximately 250 fistula procedures per year
- 80% fistula procedures by nephrologist, 20% referred to vascular surgeon
- Peer review QA by vascular surgeon (fortnightly case discussions)
- Team of dialysis nurses (vascular access); medical imaging nurses and radiographers

Endovascular maintenance

- Manage inflow and outflow stenosis (early to prevent further complications!)
- To salvage thrombosed fistulas

- I will talk through endovascular techniques for maintaining fistulas – to prevent thrombosis!

The thrombosed fistula



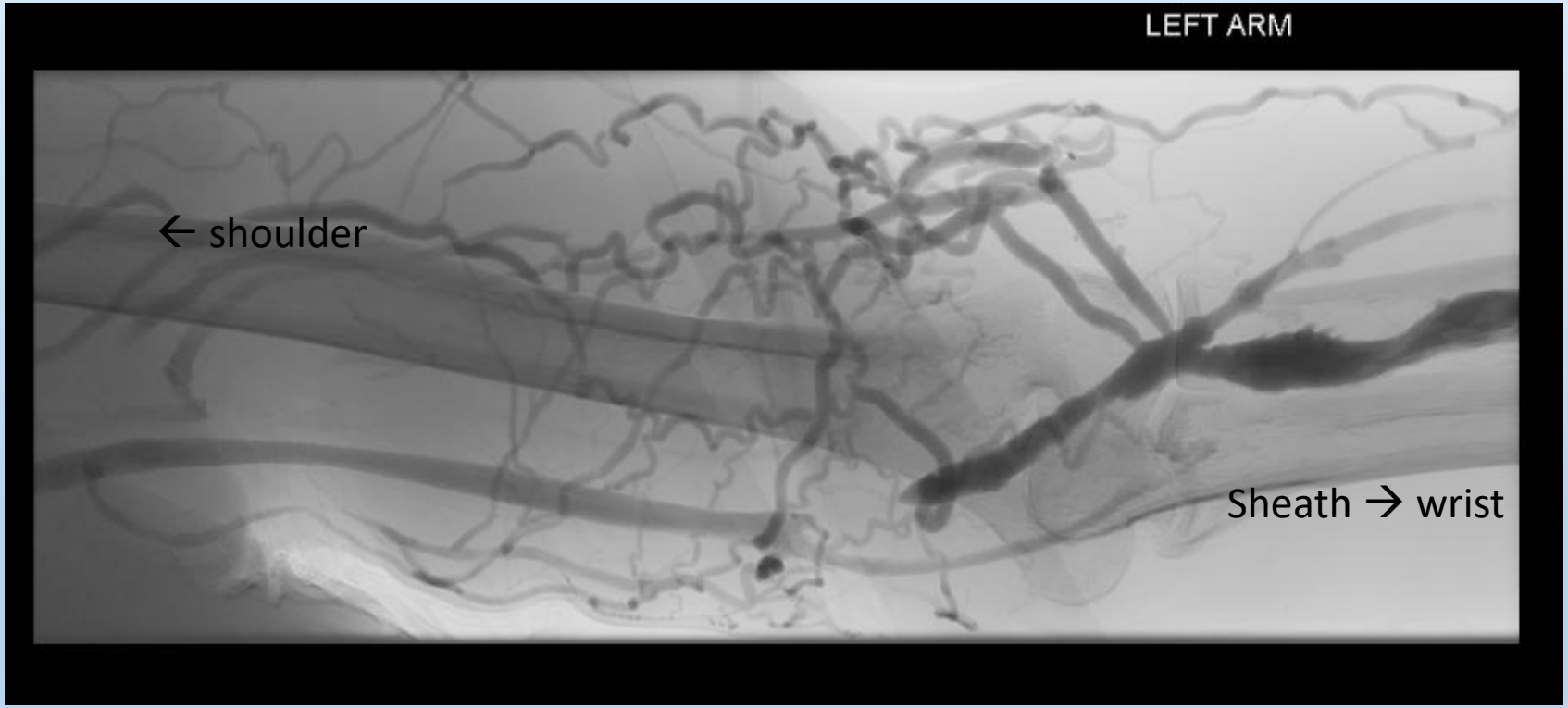
Fistula thrombosis is caused by a stenotic lesion
Approach to treatment involves options to de-clot but treating the stenotic lesion to restore flow

Balloon angioplasty

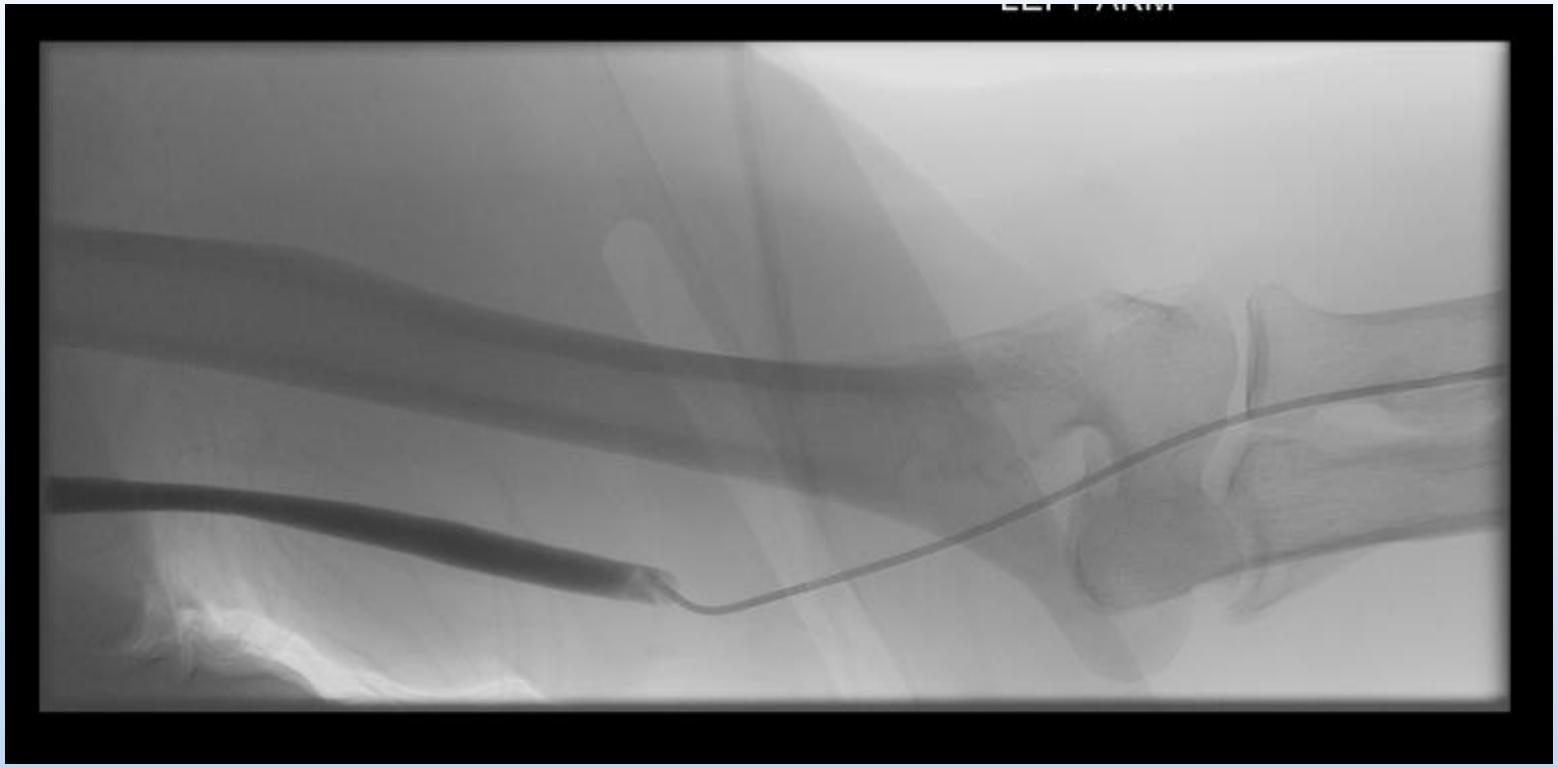
- Using some cases I’d like to demonstrate
  - The basic toolkit (POBA)
  - The role of drug-coated balloons
  - The role of cutting balloons
  - Stent grafts
  - Approach to the tight anastomotic lesion

Case 1

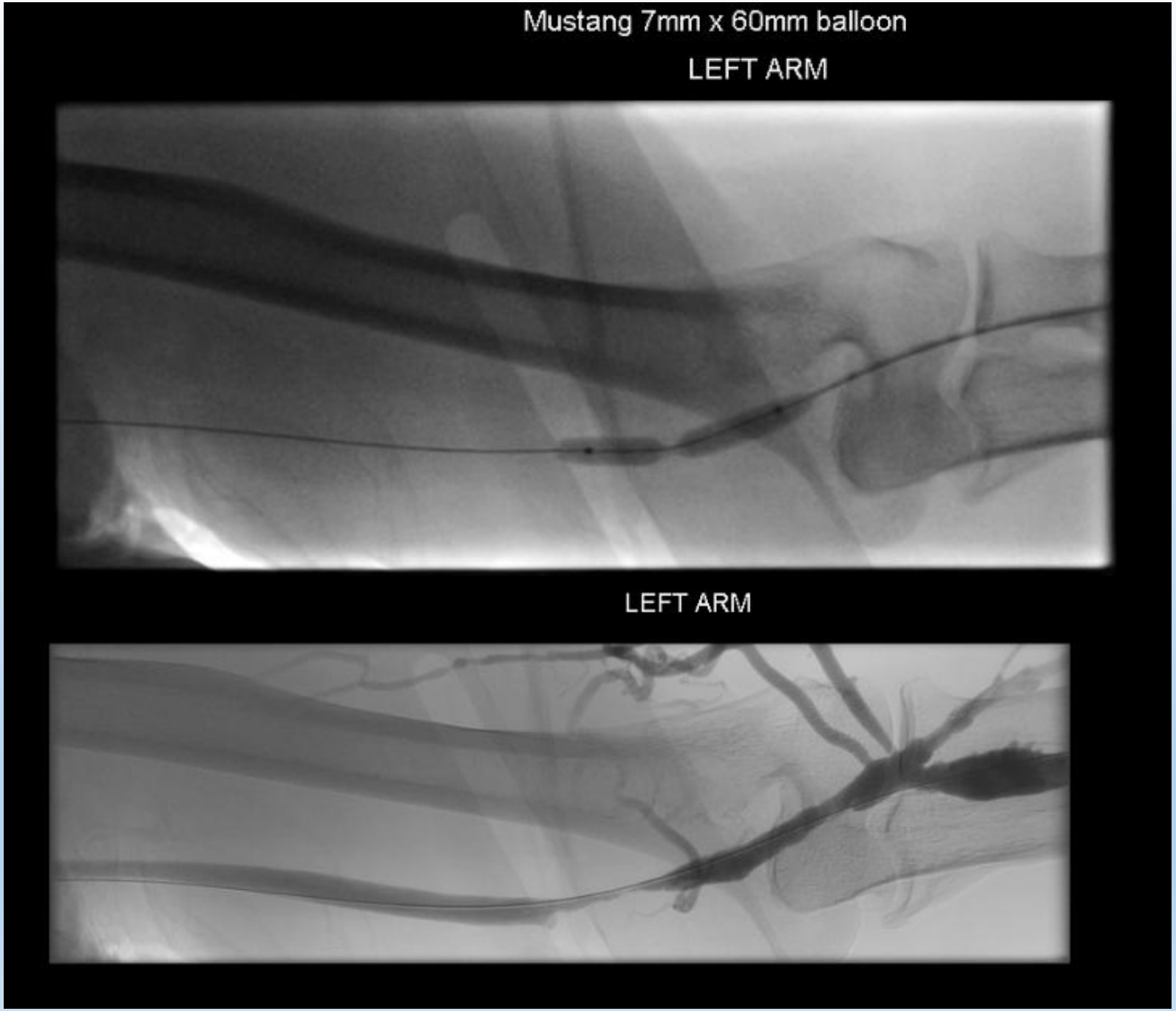
- Left radio-cephalic fistula; multiple previous interventions
- Known CTO (chronic total occlusion) at the cubital fossa



At cubital fossa – unclear dominant outflow into upper arm; lots of collaterals



- Wire navigated through CTO and catheter over wire: confirms quality basilic outflow past CTO

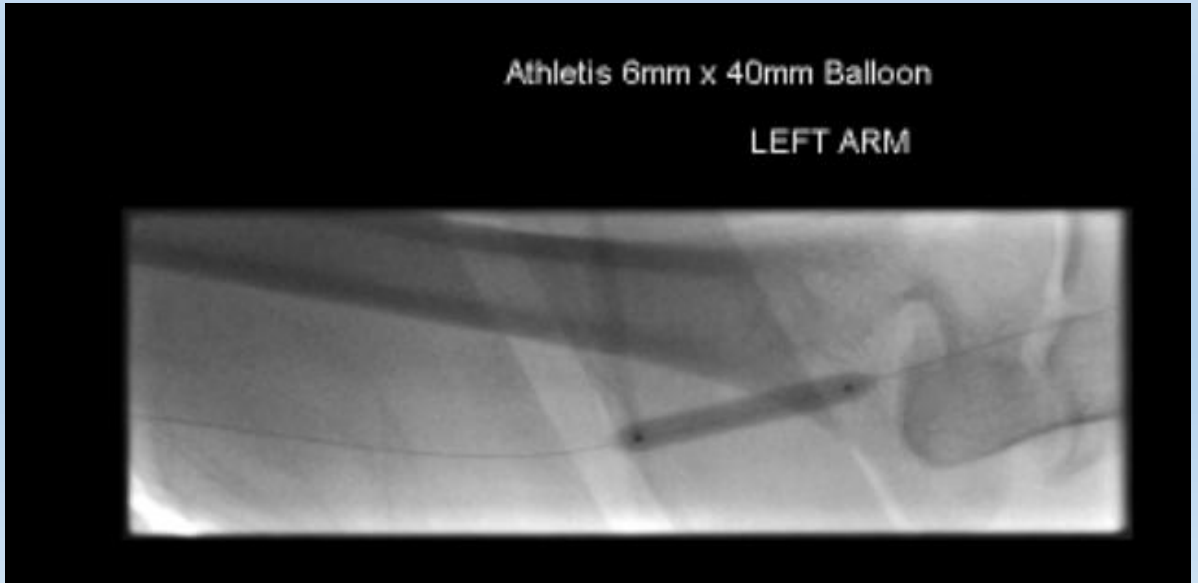


First balloon

Remnant stenosis > 50%

Cutting balloon

Ultrahigh pressure balloon

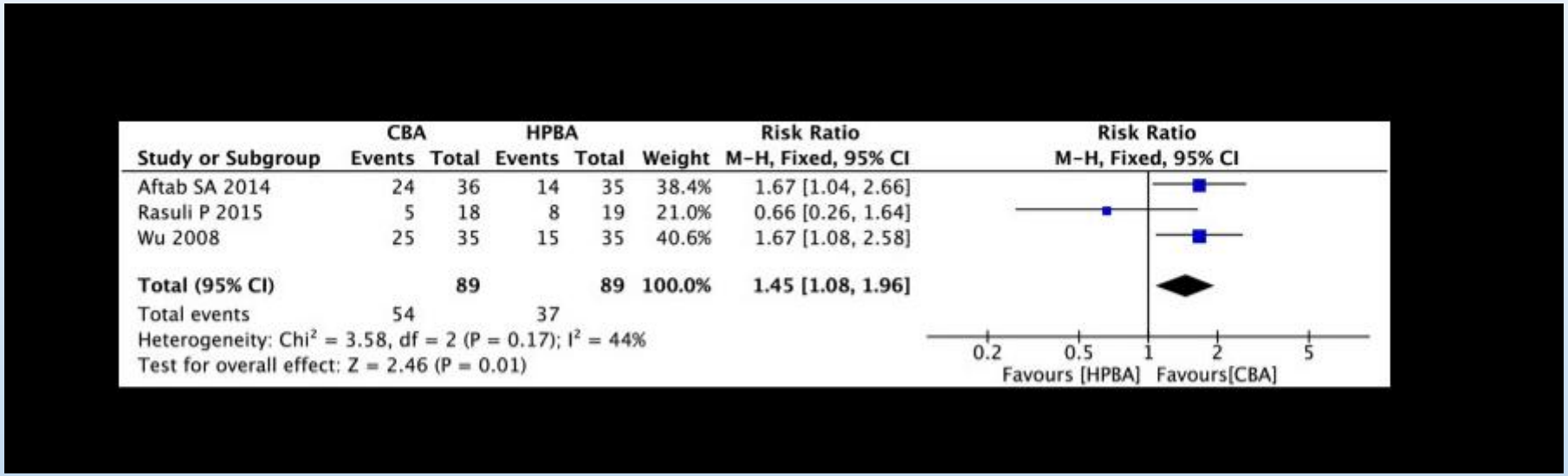


Effaced

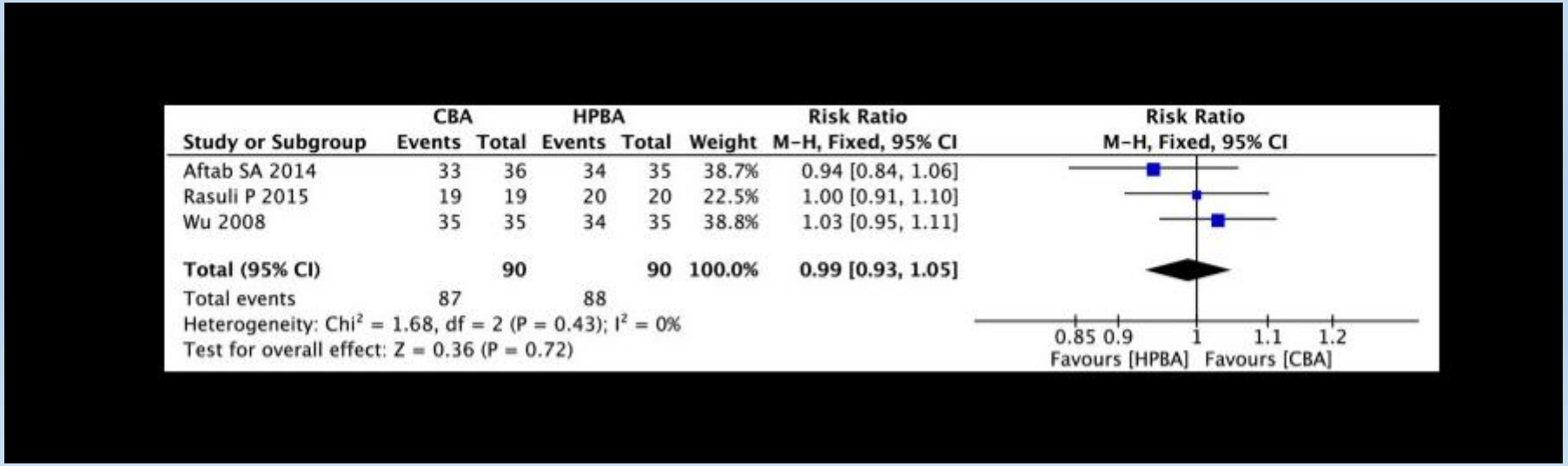
Cutting balloons

- Angioplasty can cause disruption of plaque
  - High pressure may lead to dissection – early restenosis post treatment
- Cutting balloons provide disruption of plaque
- Then allow treatment of lesion with lower pressure balloons
  - GLOBAL trial (2002) – cutting balloon use in coronary angioplasty
  - Lessons from arterial angioplasty

Cutting balloons in fistulas



Primary patency (Fistula functioning at 3 months)



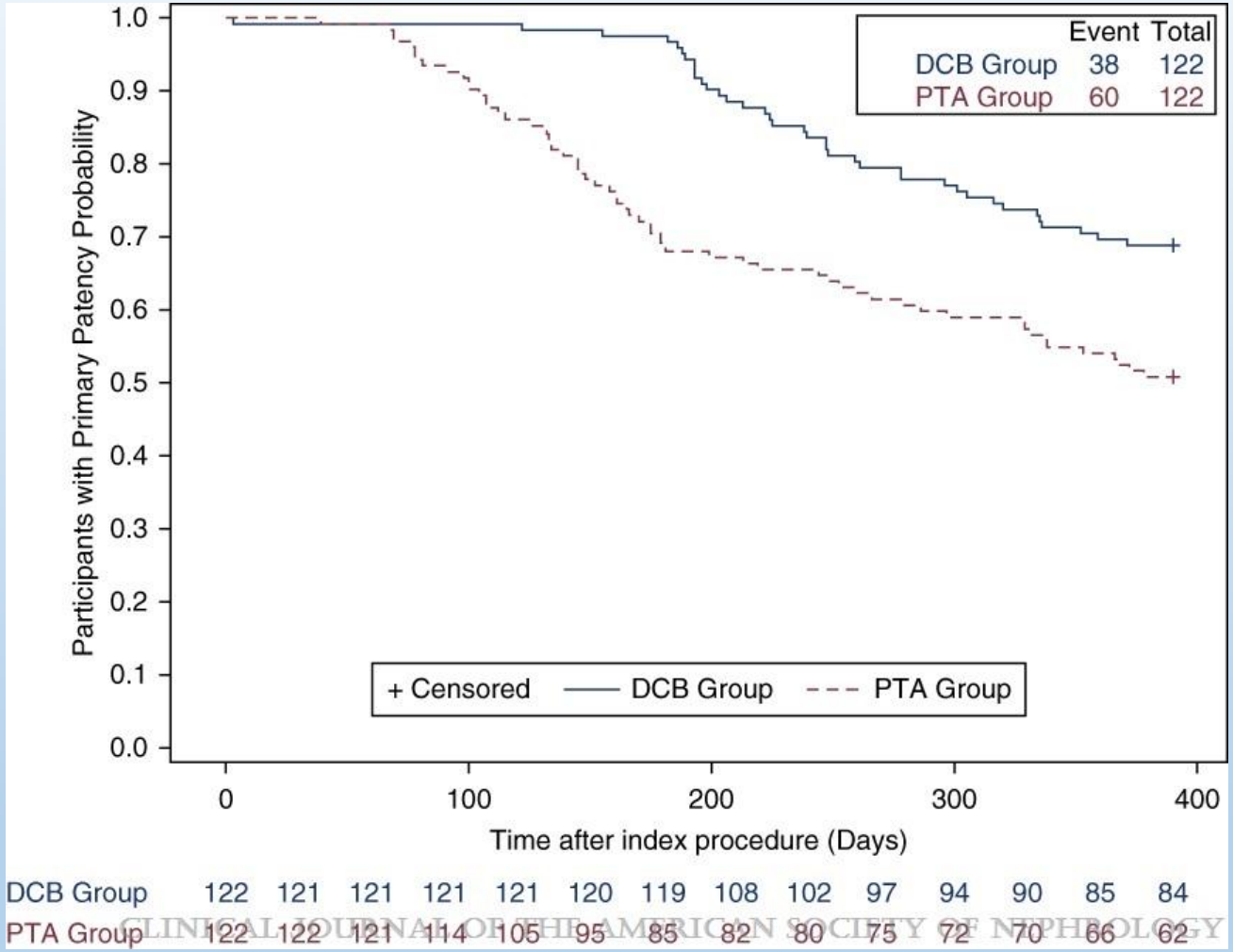
Technical success (On table lesion effacement)

Cutting balloon versus standard balloon

RCT of 40 High pressure balloons versus Cutting Balloons over 1 year: primary patency unchanged however re-stenosis free survival better in the DCB group (308 days versus 161 days)

Higher patency post DCB

Longer period before needing re-intervention



What is the efficacy and safety of paclitaxel-coated balloon angioplasty for the treatment of dysfunctional arteriovenous fistulae?

CJASN
Clinical Journal of the American Society of Nephrology

Prospective, multicenter, 1:1 RCT

N = 244 patients with ≥50% stenosis of venous segment of arteriovenous (AV) fistula

- Upper limb, mature AV fistula
- Single stenosis with significant hemodynamic changes

Predilation with a high-pressure balloon before randomization

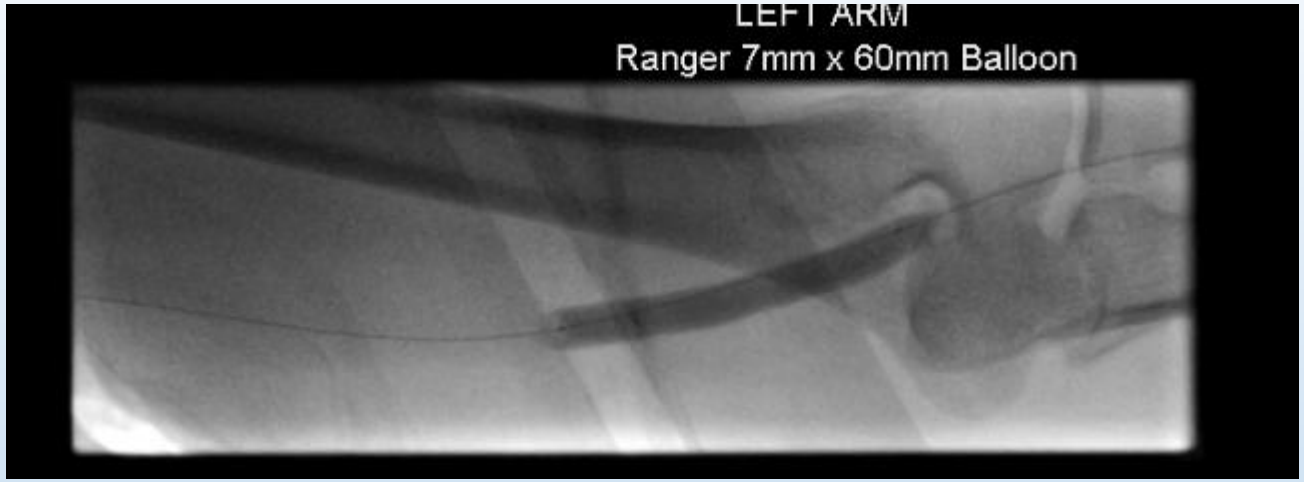
- Eligible for randomization if residual stenosis ≤30%

Results	Uncoated control balloon	Paclitaxel-coated balloon	Risk difference 95% CI
Primary patency* at 6 months	67%	91%	24% (14.7, 34.6)
Primary patency* at 12 months	46%	66%	19% (6.6, 32.1)
Major adverse events within 30 days	2.5%	0%	p=0.3
Reinterventions Mean number (SD) per patient during 12 months after procedure	0.8 (1.0)	0.4 (0.7)	-0.4% (-0.6, -0.2)

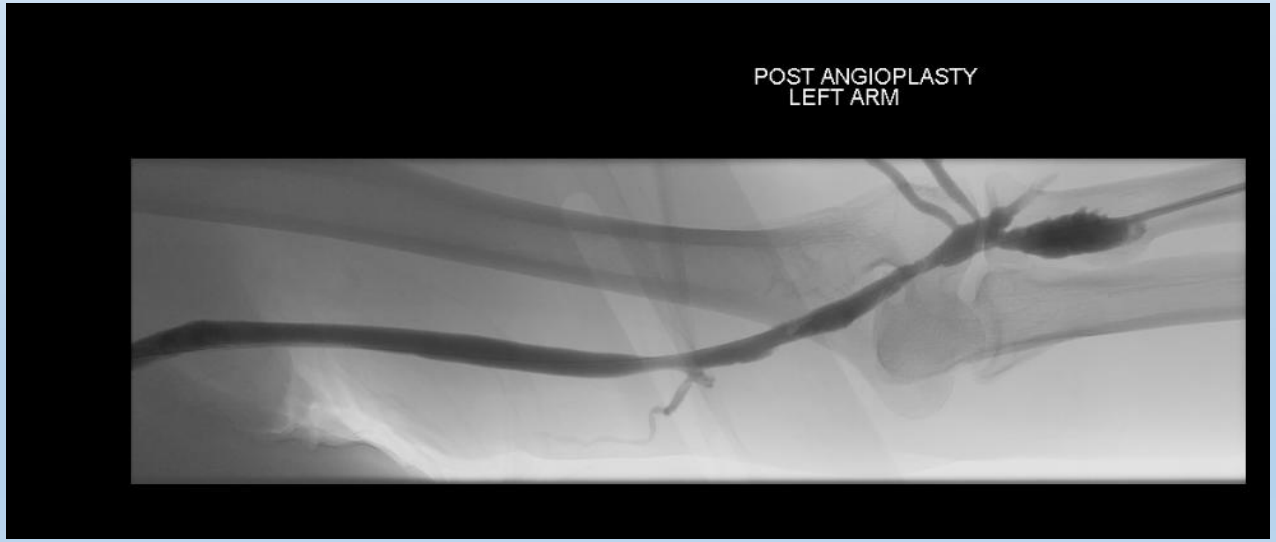
*Defined as freedom from reintervention within ±5 mm range of target lesion

Conclusions: AcoArt Orchid drug-coated balloon showed better primary patency rates compared with plain balloon angioplasty for treating stenotic lesions in dysfunctional AV fistulae at 6 months and 12 months. It required fewer repeated interventions and had comparable safety in 1 year.

Yiping Zhao, Pei Wang, Yuzhu Wang, et al. ***Drug-Coated Balloon Angioplasty for Dysfunctional Arteriovenous Hemodialysis Fistulae: A Randomized Controlled Trial.*** CJASN doi: 10.2215/CJN.0000000000000359. **Visual Abstract by Corina-Gabriela Teodosiu, MD**



Drug eluting balloon: preserve it



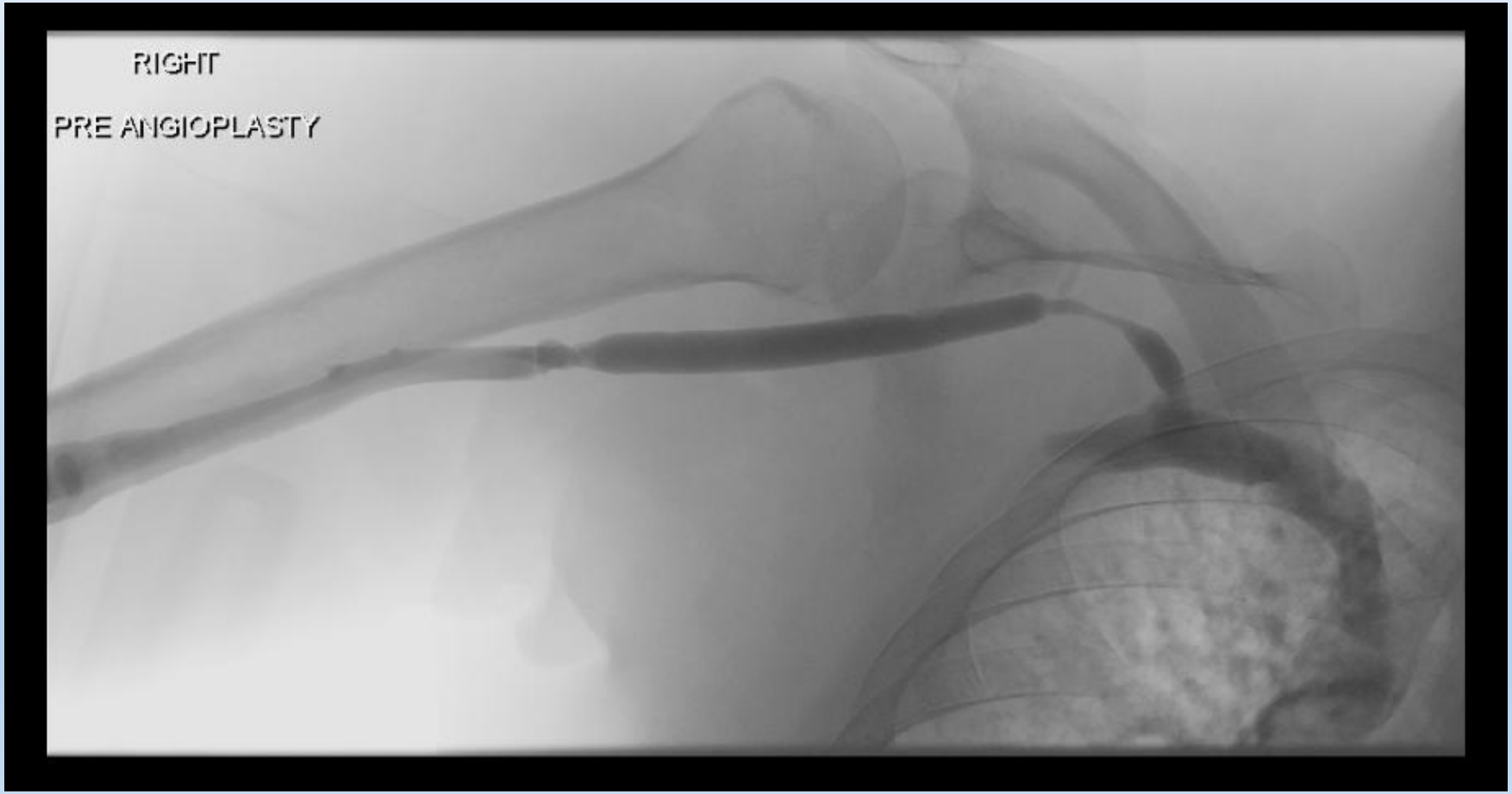
Final result
- predominant outflow, collaterals not required
- outflow pressure reduced
- flow restored
- fistula salvaged

Follow up with this case

- Recurrent CTO - treated at 6 months with repeat PTA, DEB. Subacute thrombus at JAS was treated with thrombolysis and resistant thrombus jailed with covered stent

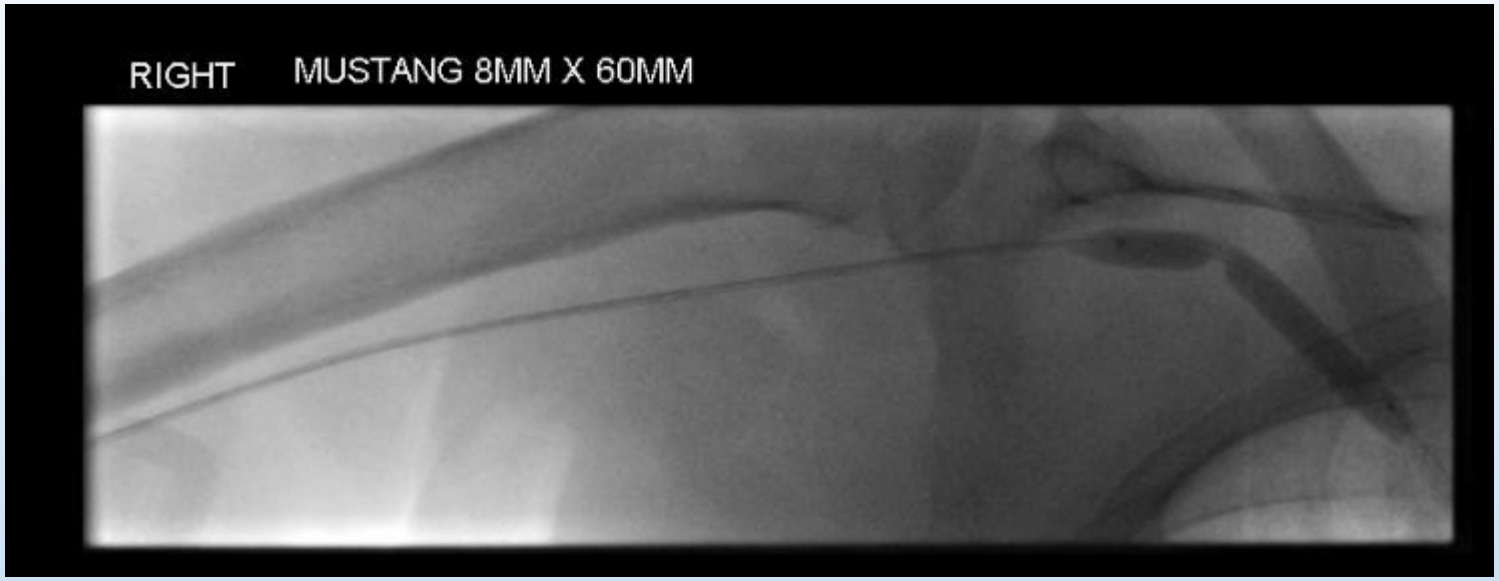
- Treated again at 12 months – covered stent across elbow – nil interventions in the last 6 months

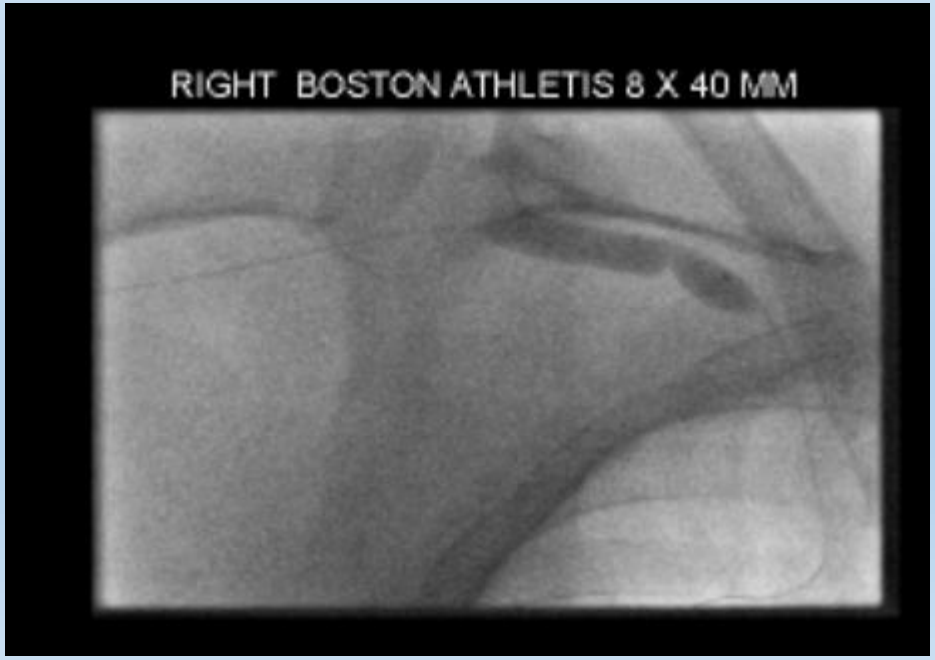
Case two: The highly resistant outflow lesion

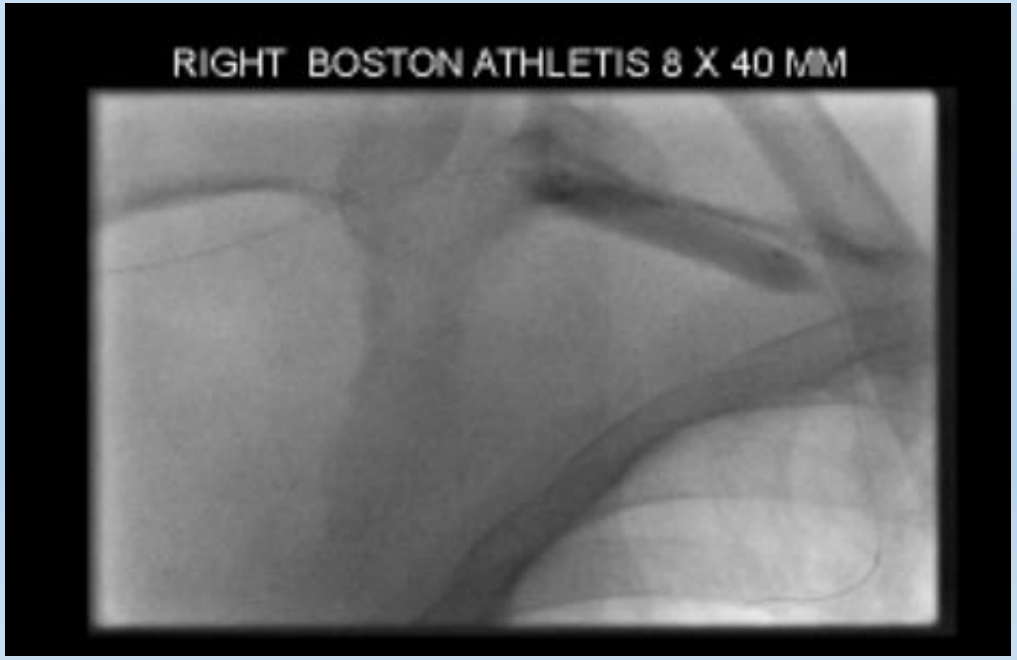


Case 2

- BG: Pt on HD for 2 years; started with tunnelled central line – has had 3 in total
- R BC AVF created and has had no previous intervention
- Dilated needling zone and high venous pressures on dialysis
- Suspicious for outflow lesion


RIGHT MUSTANG 8MM X 60MM


RIGHT BOSTON ATHLETIS 8 X 40 MM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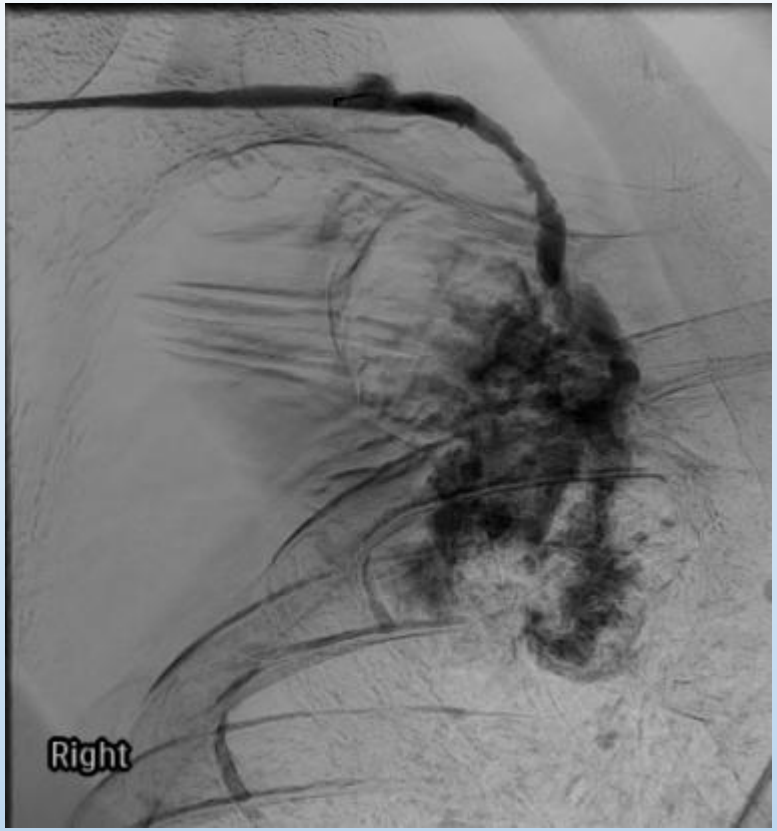
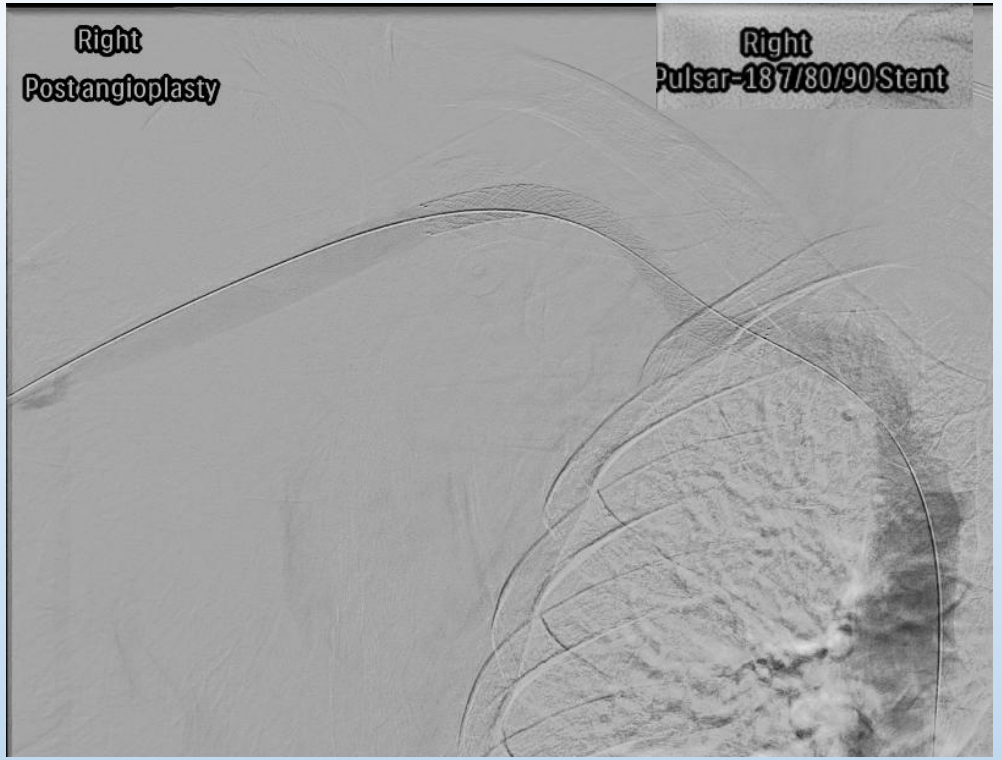




Ruptured vessel
Placement of stent – pulsar stent (not a covered stent)
Flow restored

Stents – special equipment

Recurrent stenosis resistant to PTA

Vessel rupture

Pseudoaneurysm

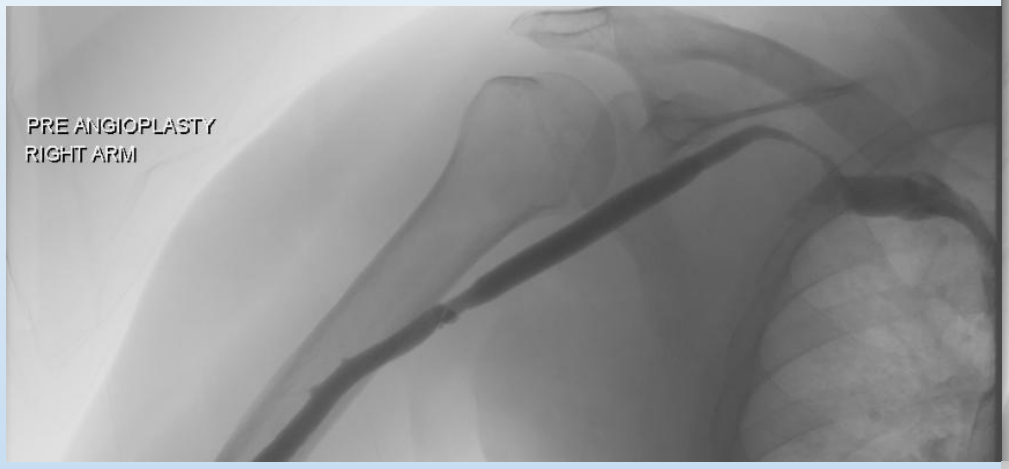
Recurrent non occlusive thrombus formation

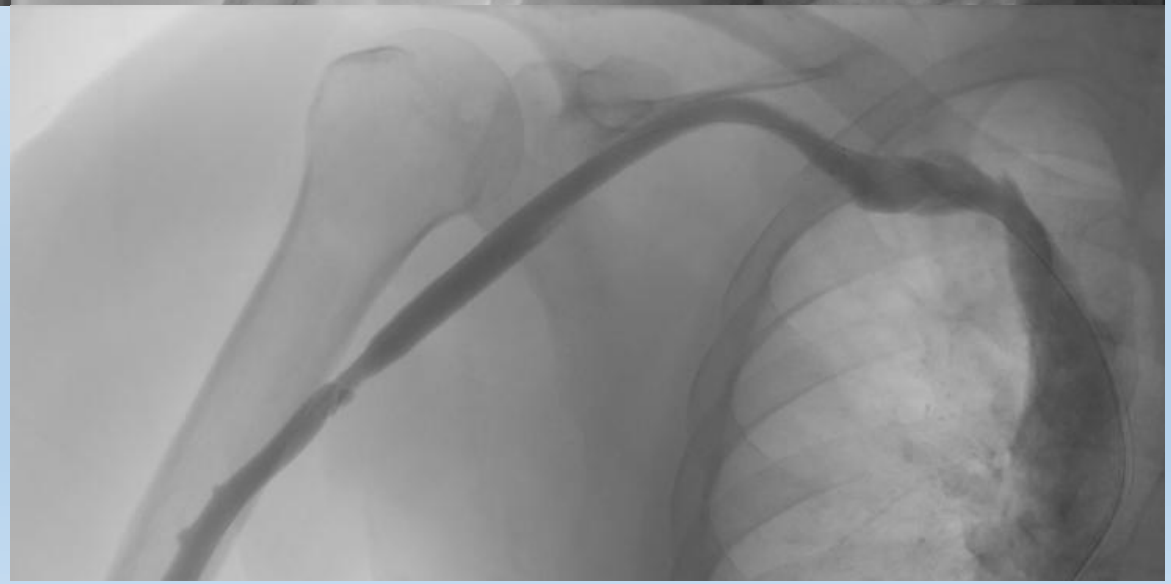
Acute PTA failure

- They are prone to
  - Crushing, fragmentation: avoid use in needling zones and across joints (although these may be necessary)
  - Migration – measure twice, deploy once
- They need to be self-expanding (protection against crushing): nitinol based
- Bare metal stents are not superior to angioplasty alone

- Recurrent cephalic arch stenosis: stent grafts have high primary patency (HR 4.1; 1.9-20.3) compared to BMS (n = 25; Shemesh et al)

3 months later





Stent graft RCT

In the Arteriovenous (AV) Stent Graft in the Treatment of Venous Outflow Stenosis in AV Fistula Access Circuits (AVeNEW) trial, the 6-month TLPP was significantly higher for stent graft as compared to PTA alone (78.7% vs. 47.9%, $P < 0.001$).

Six-month safety and efficacy outcomes from the randomized-controlled arm of the WRAPSODY Arteriovenous Access Efficacy (WAVE) trial

kidney INTERNATIONAL

ISN INTERNATIONAL SOCIETY OF NEPHROLOGY

Study Design & Patient Cohorts

- Prospective, randomized-controlled study conducted across 43 centers worldwide comparing clinical outcomes of patients on hemodialysis who experienced stenosis in their arteriovenous fistula
- A total of 245 patients were randomized 1:1 to receive treatment with percutaneous transluminal angioplasty (PTA, n=123) or a cell-impermeable endoprosthesis (CIE, n=122)

Study Measures

Safety:

Freedom from safety events 30 days following interventional procedure

Efficacy:

6-month Target lesion primary patency (TLPP)
6-month Access circuit primary patency (ACPP)

Results

Safety: No difference in the proportion of patients free from safety events 30 days post procedure (CIE: 96.6%, PTA: 95.0%; p<0.0001 for non-inferiority; p=0.54 for superiority)

Efficacy: Patency rates were significantly higher for patients treated with the CIE versus PTA (Fig.)

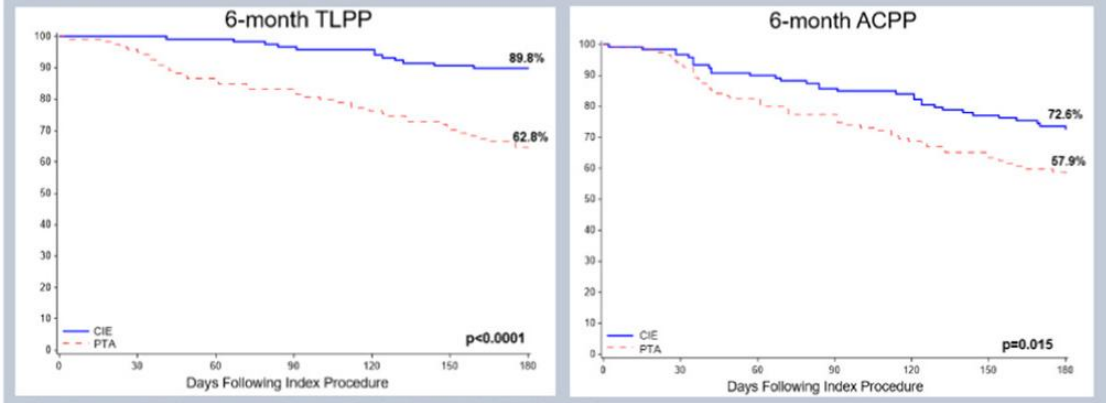


Fig. Kaplan-Meier curves for TLPP (left) and ACPP (right)

Razavi et al., 2024

CONCLUSION

The CIE was associated with significantly higher 6-month TLPP and ACPP versus PTA without any difference in device safety.

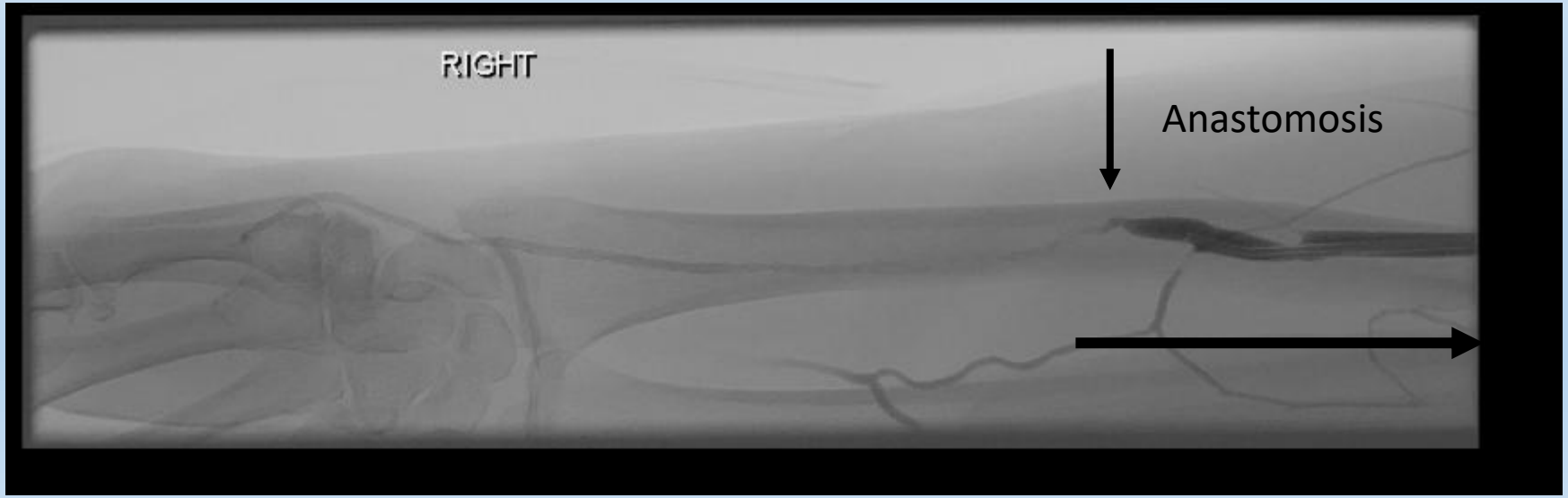
Stent graft pitfalls

- Can have more favourable outcomes than PTA alone however
  - Outflow pitfalls
  - Cephalic arch pitfalls

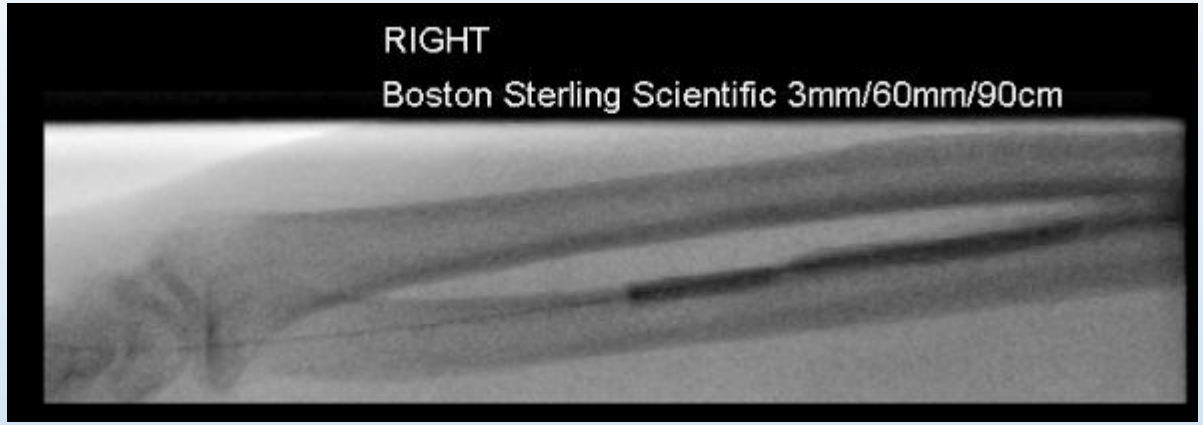
Case 3

- The anastomotic lesion with poor maturation: an approach

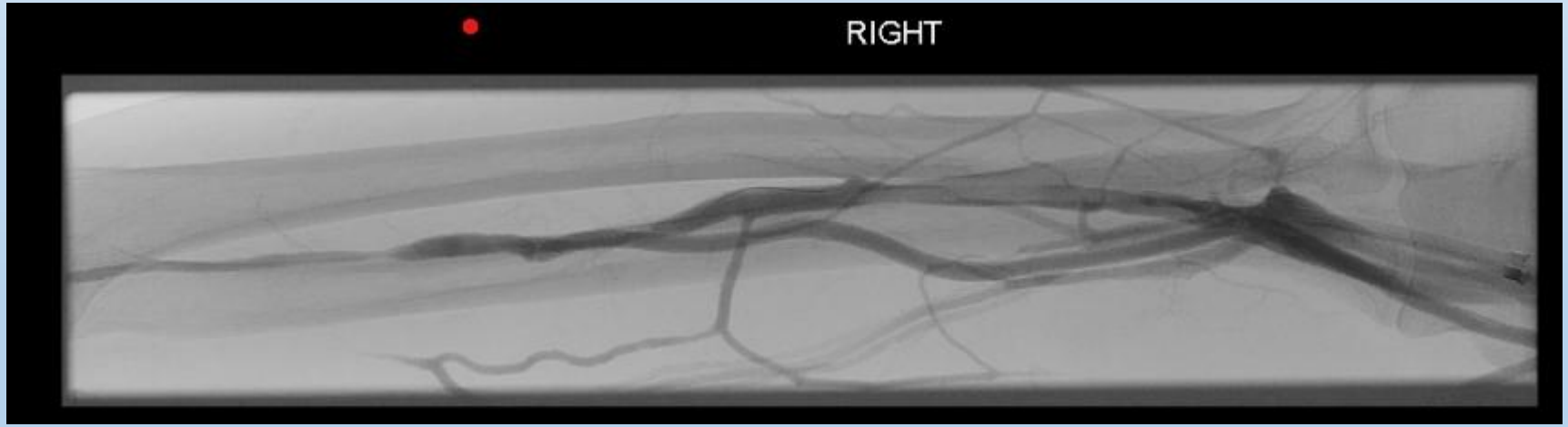
- 2ND AVF created with poor maturation of vessel; using tunnelled central line for dialysis



- Options: Balloon angioplasty



- Lesion at anastomosis improved but remains present



PTA maturation – the failure to mature fistula

- Maturation of fistulas a wide problem – numbers reported vary as many factors may result in poor maturation
- Larger cohorts report numbers around 20-40% fail to mature; of these 30-80% might mature post intervention
- (DOPPs) reports a functional patency of 88% at 1 year – Al-Jaisi et al reported 71% (including the primary failure rate of 23%)

JAS stenting with aggressive balloon dilatation (Swinnen et al)

- Pre-plan the size of the stenotic JAS area
- Access retrograde (venous side) and then ‘around the corner’ to allow anterograde imaging
- Angioplasty of the lesions – high pressure and cutting balloons
- Uncovered nitonol stent placed – diameter to match inflow and ouflow (6mm despite ~3mm artery), up to 100mm length

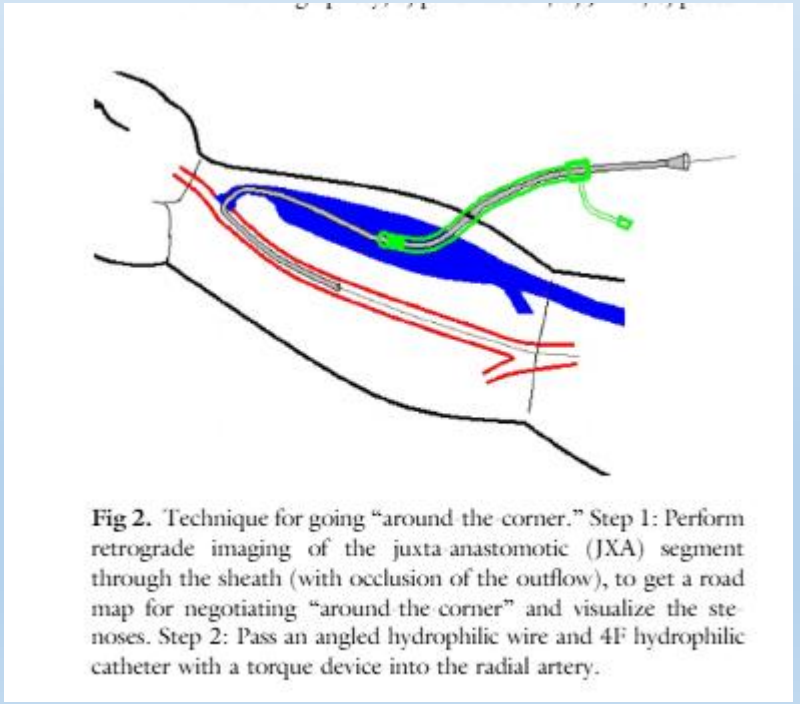


Fig 2. Technique for going “around the corner.” Step 1: Perform retrograde imaging of the juxta anastomotic (JXA) segment through the sheath (with occlusion of the outflow), to get a road map for negotiating “around the corner” and visualize the ste noses. Step 2: Pass an angled hydrophilic wire and 4F hydrophilic catheter with a torque device into the radial artery.

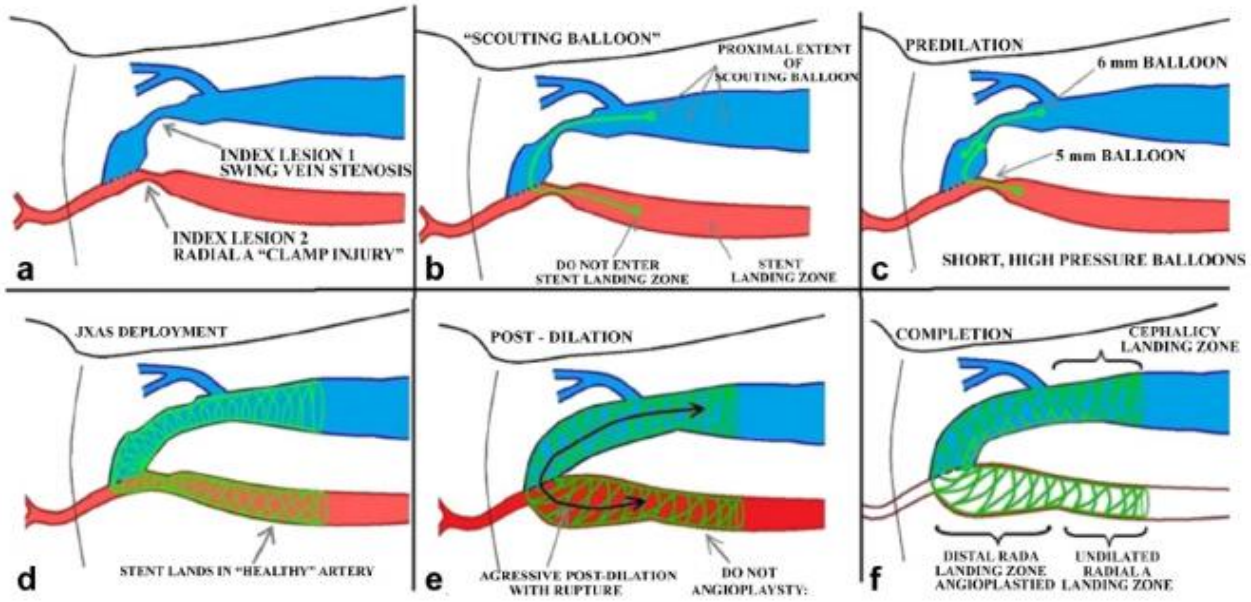
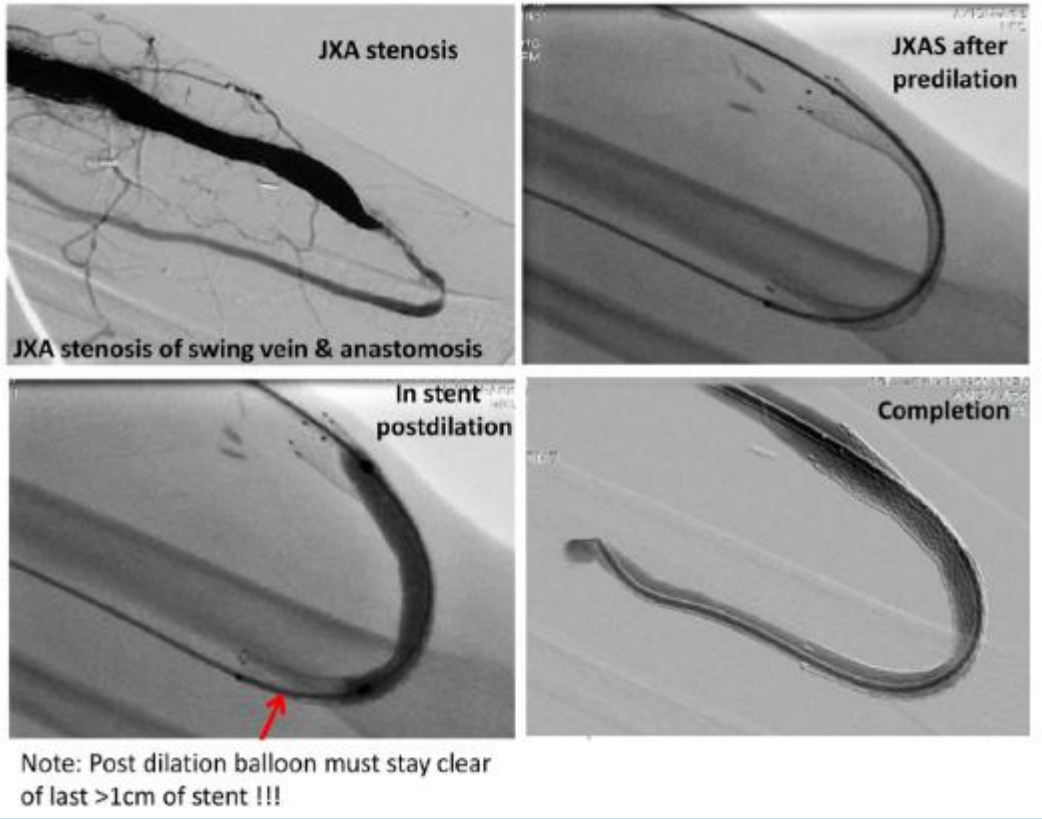


Fig 1. The juxta anastomotic (JXA) segment and the steps in JXA stenting (*JXAS*). **a,** JXA stenosis; **b,** scouting balloon angioplasty; **c,** predilatation; **d,** JXAS; **e,** postdilatation; **f,** completion.



Outcomes:

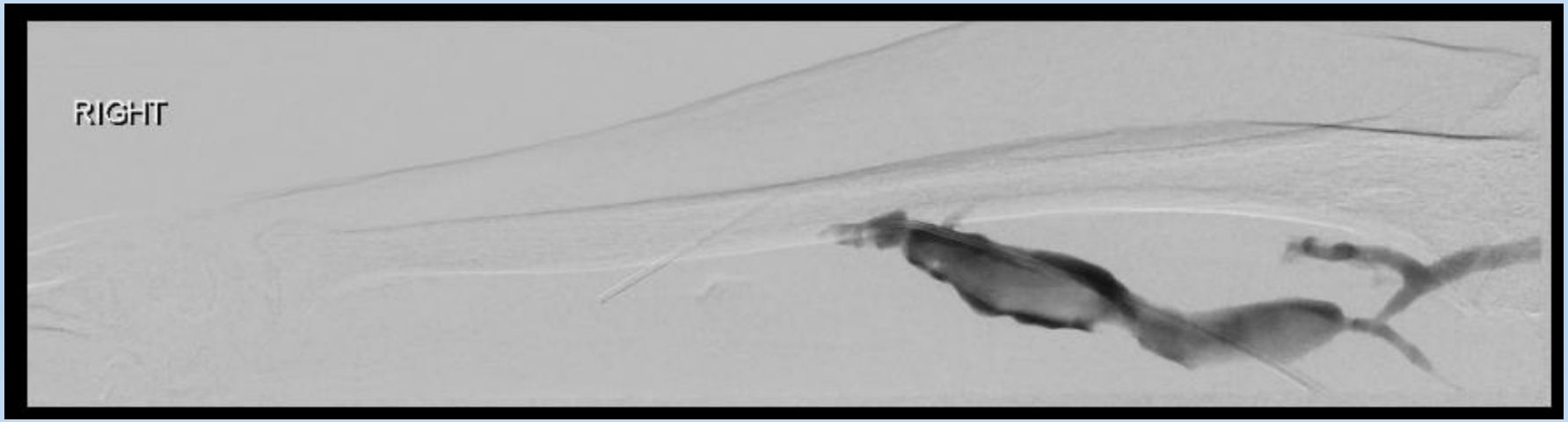
68 fistulas (33 failure to mature): 2 technical failures on table. 75% of FTM fistulas matured at 6 and 88% at 12 months; assisted patency 90% 2 years, 80% 4 years
(Swinnen et al 2015)

Balloons

- Simple plasty of lesions
- Compliant lesions – a standard pressure balloon
- Non compliant lesions
  - High and ultra high pressure balloon
  - Cutting balloon
- Lesions that are likely to recur
  - Drug eluting balloons
- Choose the appropriate diameter (1mm greater than pre/post stenotic segment)
- Choose the appropriate length (5mm either side of stenosis)
  - Smaller length balloons apply a greater radial pressure at mid zone

Thrombosed fistulas

- Require early salvage: within 48-72 hours for best results
- Endovascular salvage is a good option unless clot burden is very high (upper arm fistula) – similar outcomes compared to surgical thrombectomy (on table restoration 70-95%; primary patency rates similar at 6, 12 months Nikam et all 2015)

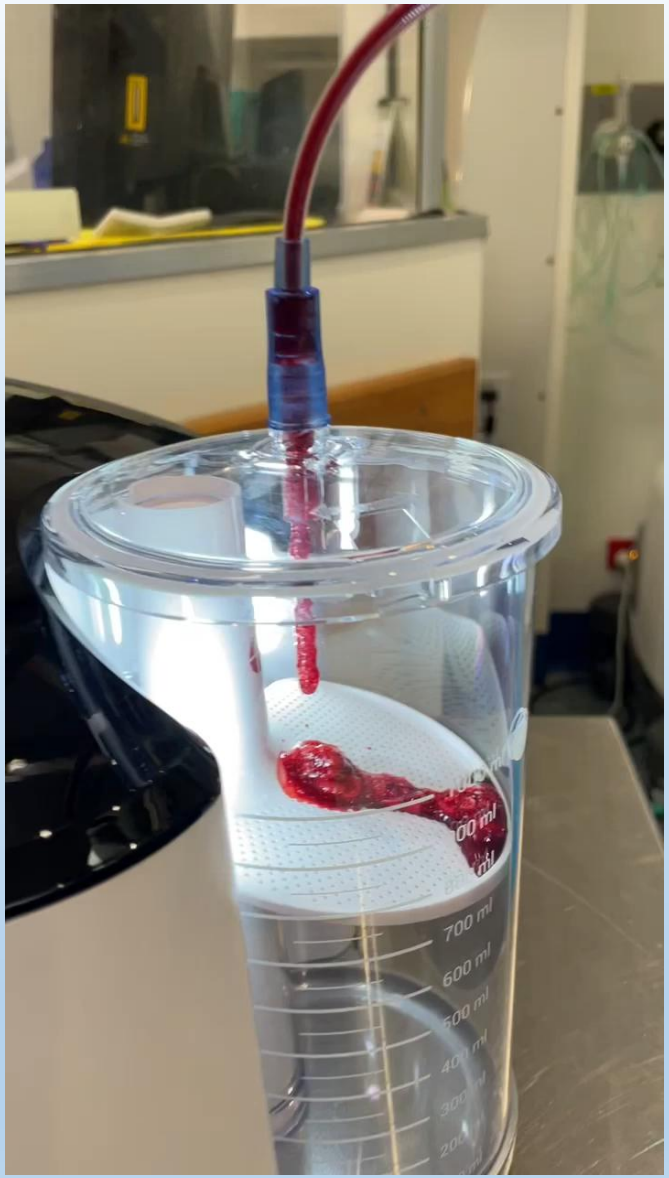


Declot options

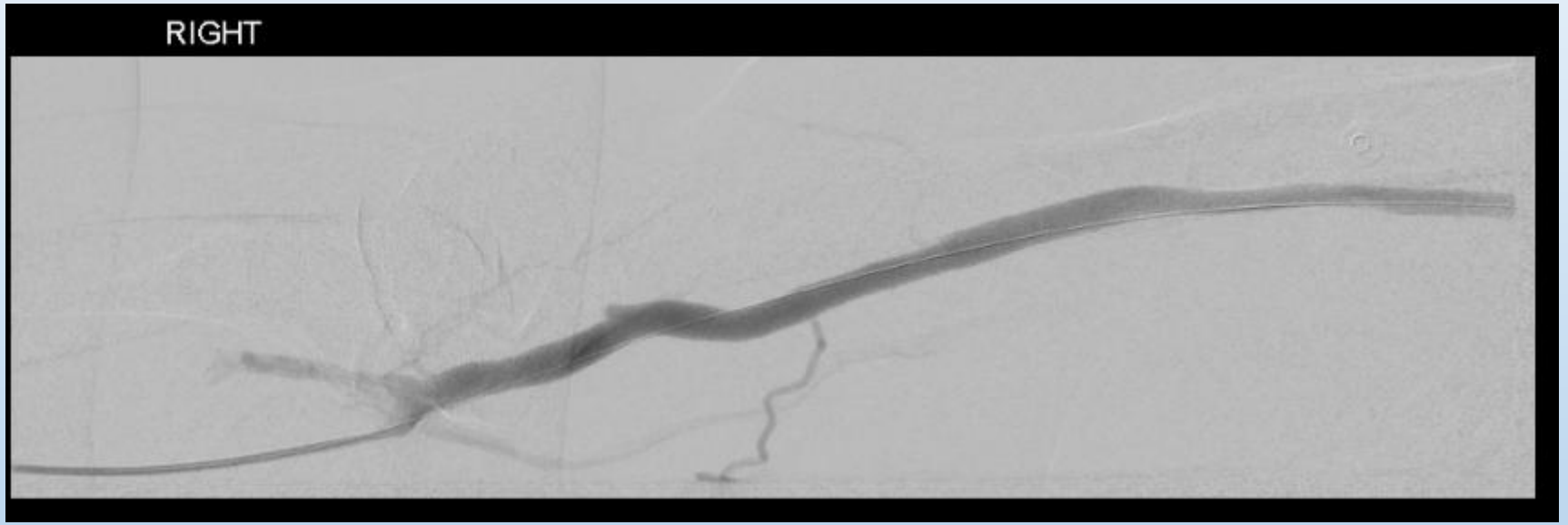
- ‘Lyse and wait’ – instill thrombolytic and wait up to 24 hours (consider bleeding complications)
- Balloon maceration – use a balloon to push clot against the wall of the vessel (best success ASAP after thrombosis onset; with small clot burden)
- Push/pull – using balloon inflation to ‘push’ thrombus to venous outflow; pull/suction via sheath to remove clot
- Mechanical thrombectomy – numerous commercial devices – 70+; aspiration thrombectomy (aspiration post combination of thrombolytic + saline spray + maceration + Bernouli effect)

A declotting device (Indigo system) – clot extraction

Manual (push/pull) declot

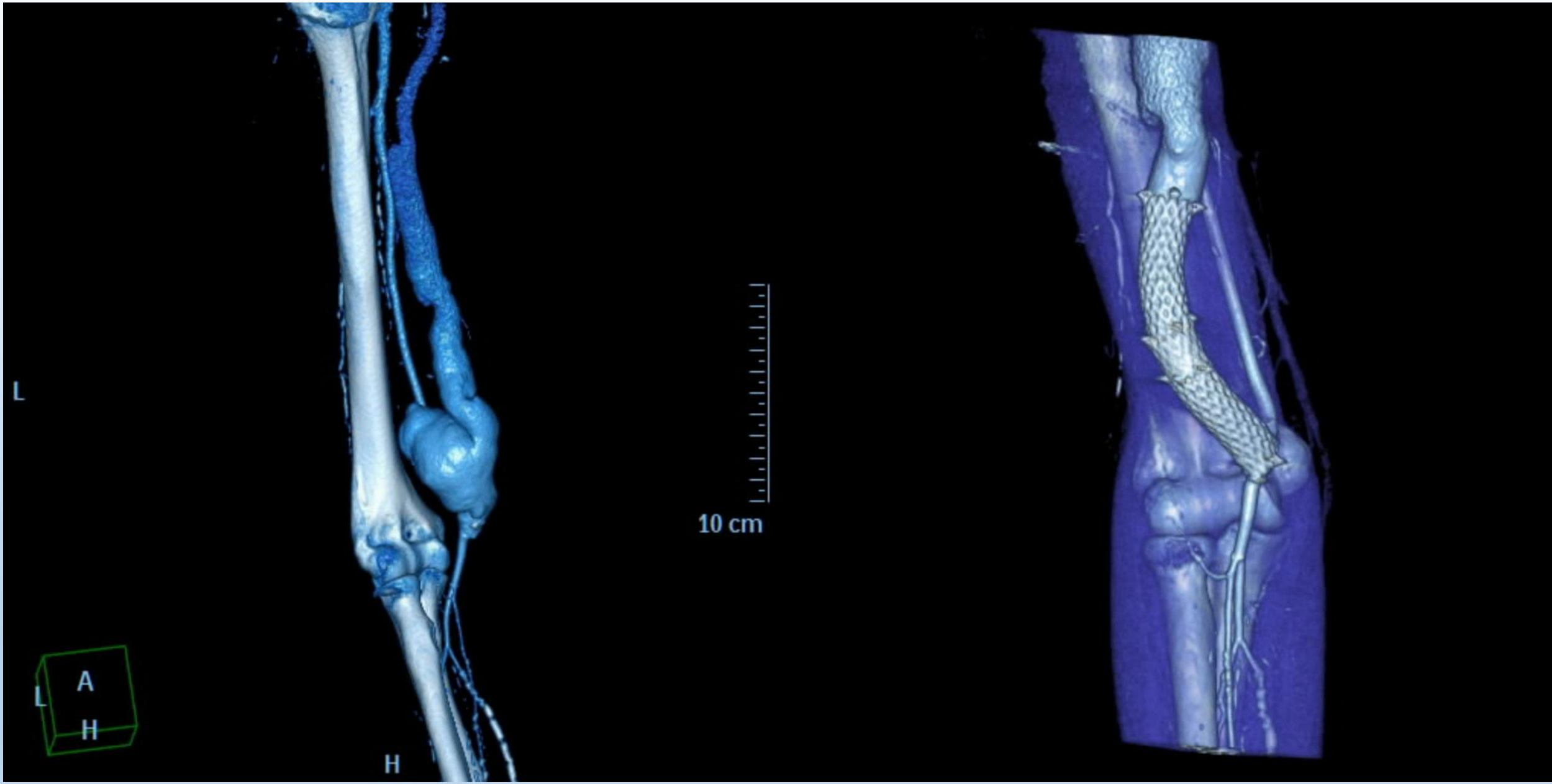


Small clot burden, only thrombosed hours



1. Lyse and wait
2. Outflow lesion treated (PTA)
3. Balloon maceration through outflow
4. Flow restored, fistula salvaged

Aneurysmal fistulas – endovascular repair!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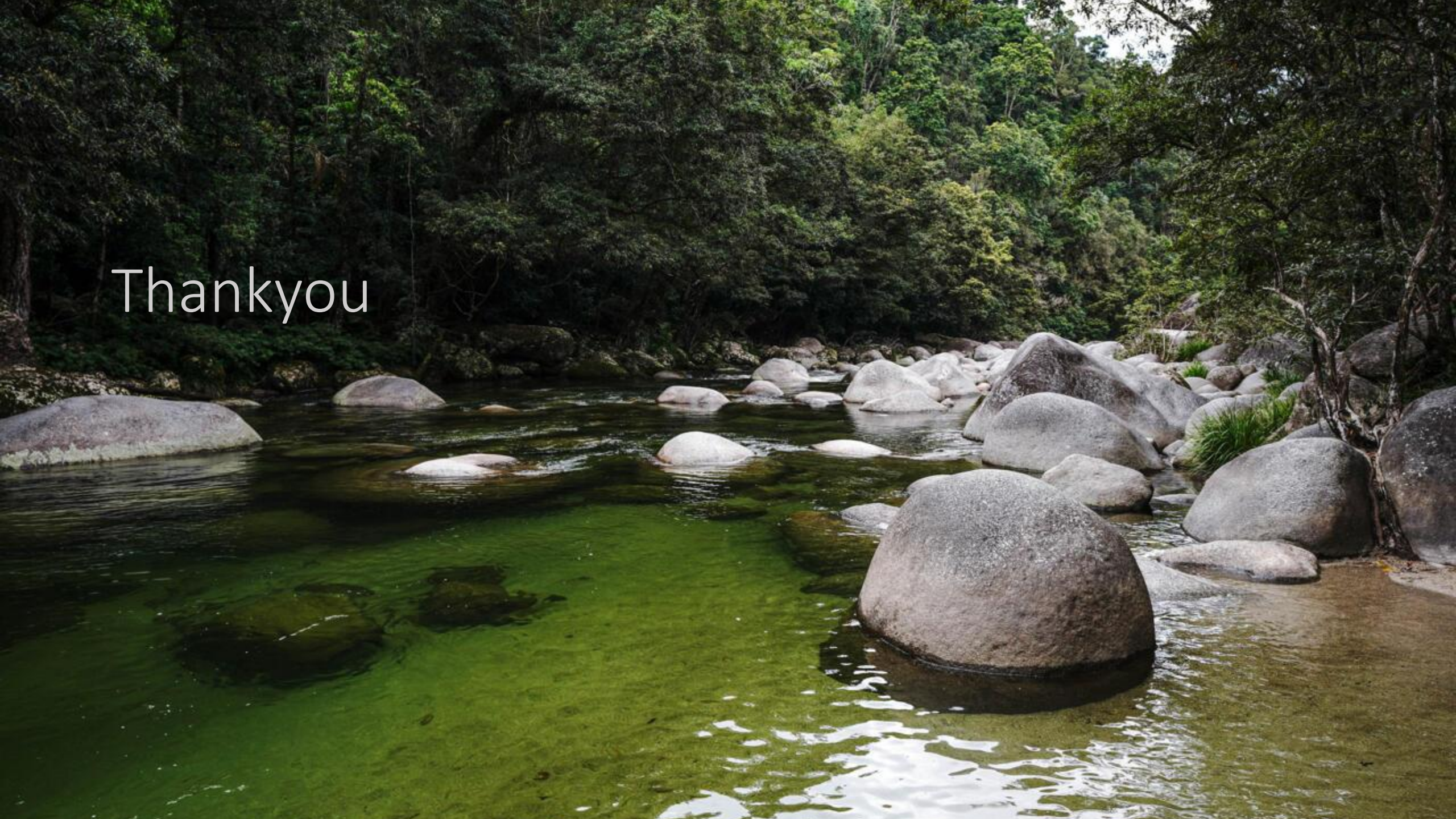
Thankyou