

Reducing Complications in CTO PCI



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Potential Conflicts of Interest

I have the following potential conflicts of interest to report:

Grant/Research Support: Asahi Intecc

Proctoring Fees/ Speakers Honoraria: Boston Scientific, Medtronic, Abbott Vascular,
Kaneka, Bio-Excel, Teleflex Medical

Global Consensus Recommendations on Improving the Safety of Chronic Total Occlusion Interventions

Dr Eugene B Wu, Dr Arun Kalyanasundaram, ES
Brilakis, K Mashayekhi, E Tsuchikane.

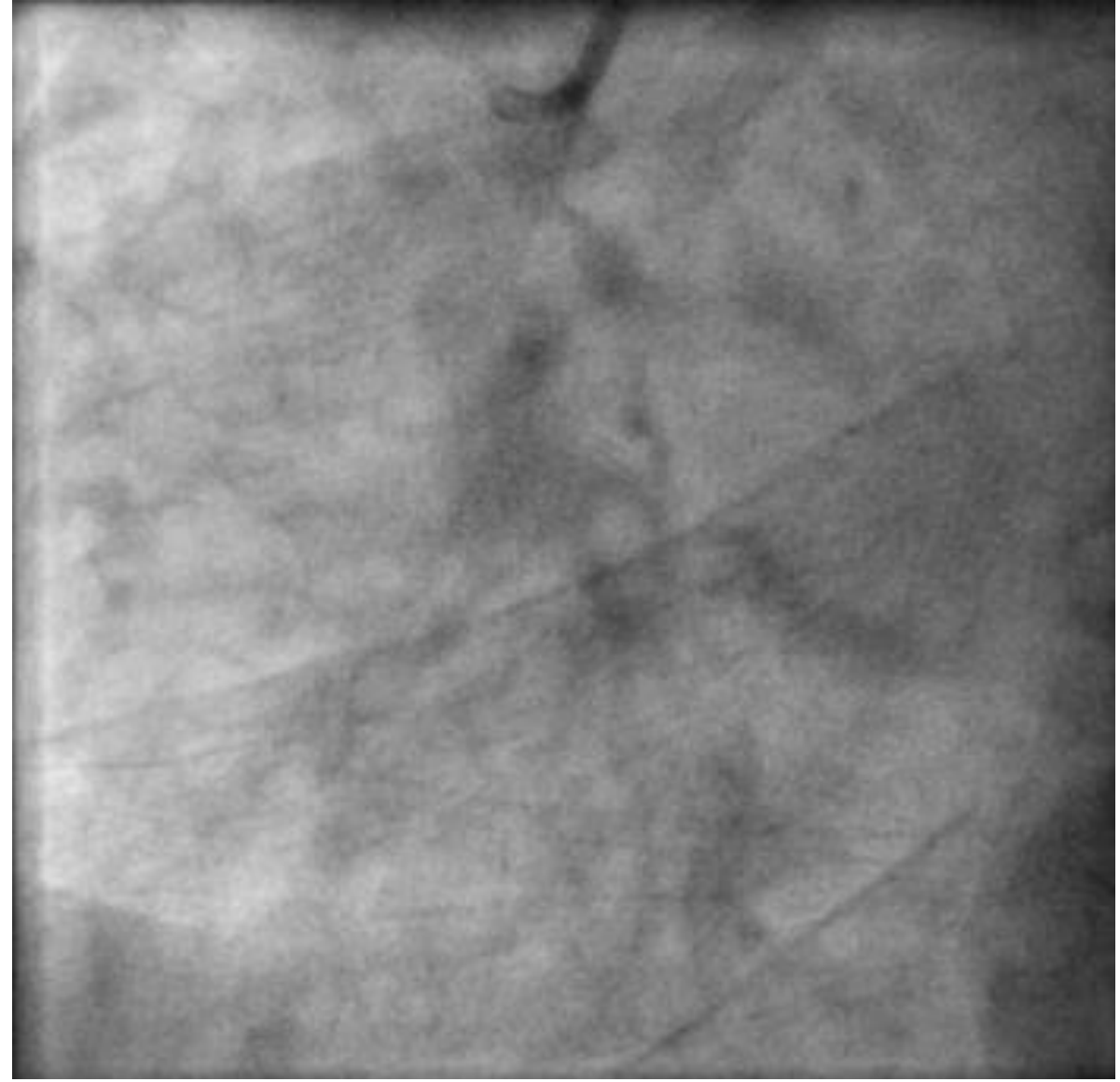
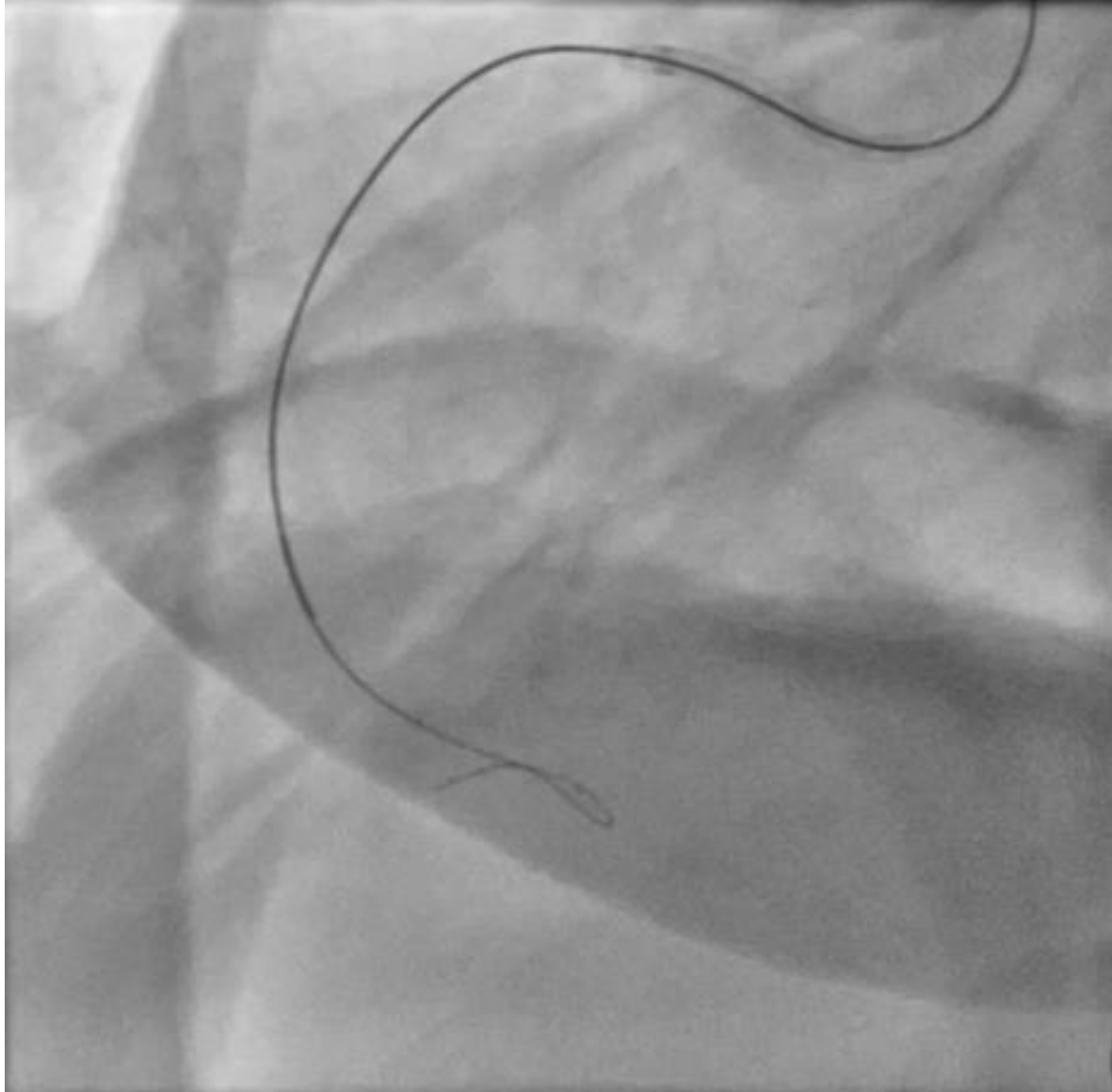
147 authors from 139 centres in 52 countries developed
12 sets of recommendations for the prevention, early
recognition, and treatment of CTO PCI complications

1. Set up for Safe CTO PCI

- Procedural check list and formal time out
- Access to appropriate equipment
- Careful reading of the angiogram
- Be familiar with complications that may occur and have an algorithmic approach to solving them
- Create a horizontal cath lab team
- Establish an emergency response team for the cath lab



2. Guide Catheter Associated Vessel Injury



Dissection or Equipment Related Donor Vessel Injury

Caution with:

- Extra backup guides deep seated for support
- Forceful contrast injections
 - Particularly if there is pressure damping
- Donor vessel disease
- Externalizing
 - Disengage and watch donor guide
 - Protect donor vessel collaterals with microcatheter

Management Iatrogenic Dissection

STOP INJECTING CONTRAST
disconnect injector

STOP INJECTING CONTRAST
disconnect injector

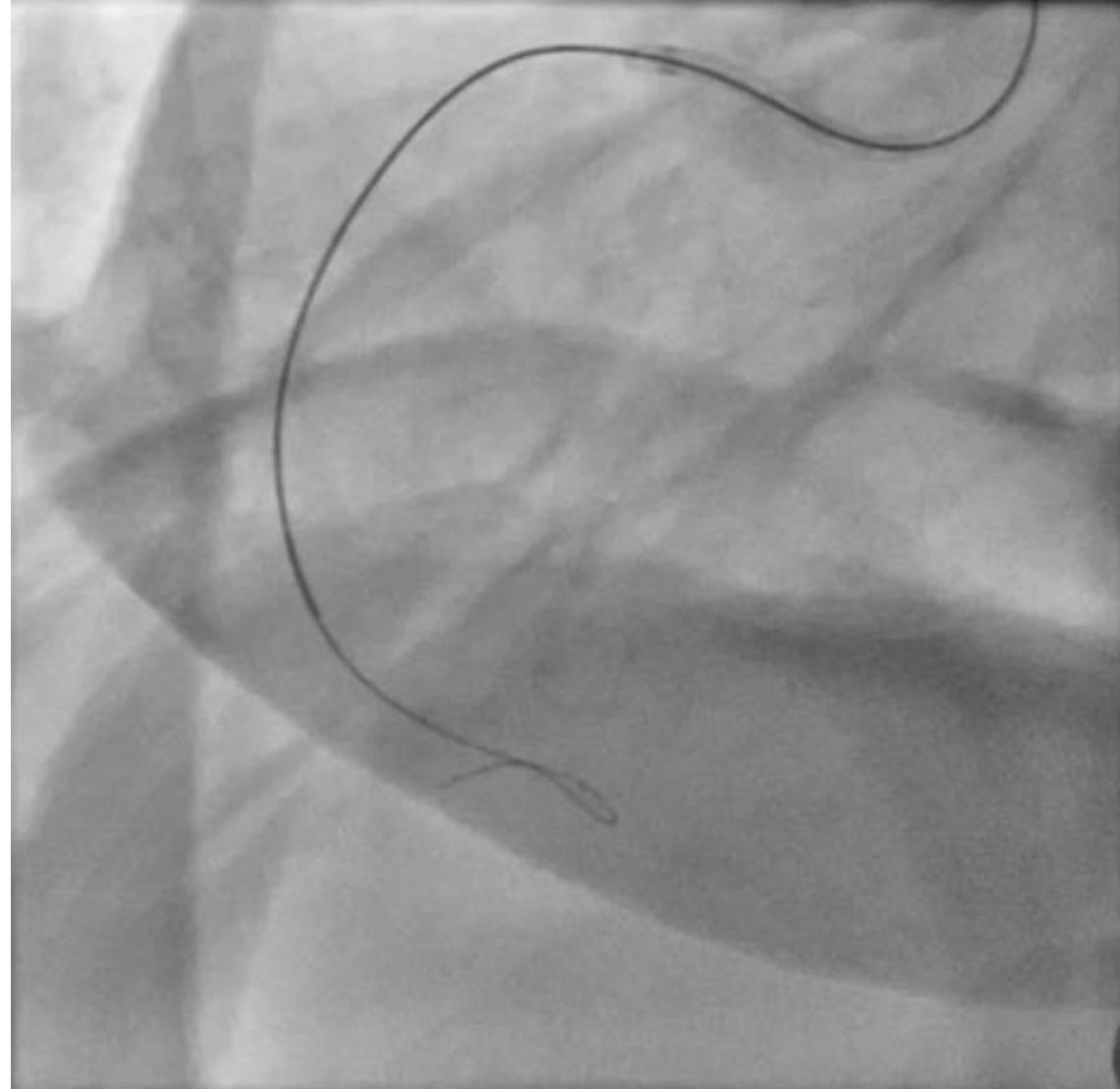
STOP INJECTING CONTRAST
disconnect injector

STOP INJECTING CONTRAST
disconnect injector

STOP INJECTING CONTRAST
disconnect injector

Iatrogenic Aortic Dissection

- 1) STOP antegrade contrast injection
- 2) Fix the ostium with a stent (or even covered stent)
- 3) Echocardiogram
- 4) Reverse heparin (once gear is out of coronaries)
- 5) CT scan
- 6) Surgical consult
- 7) Blood pressure/heart rate control

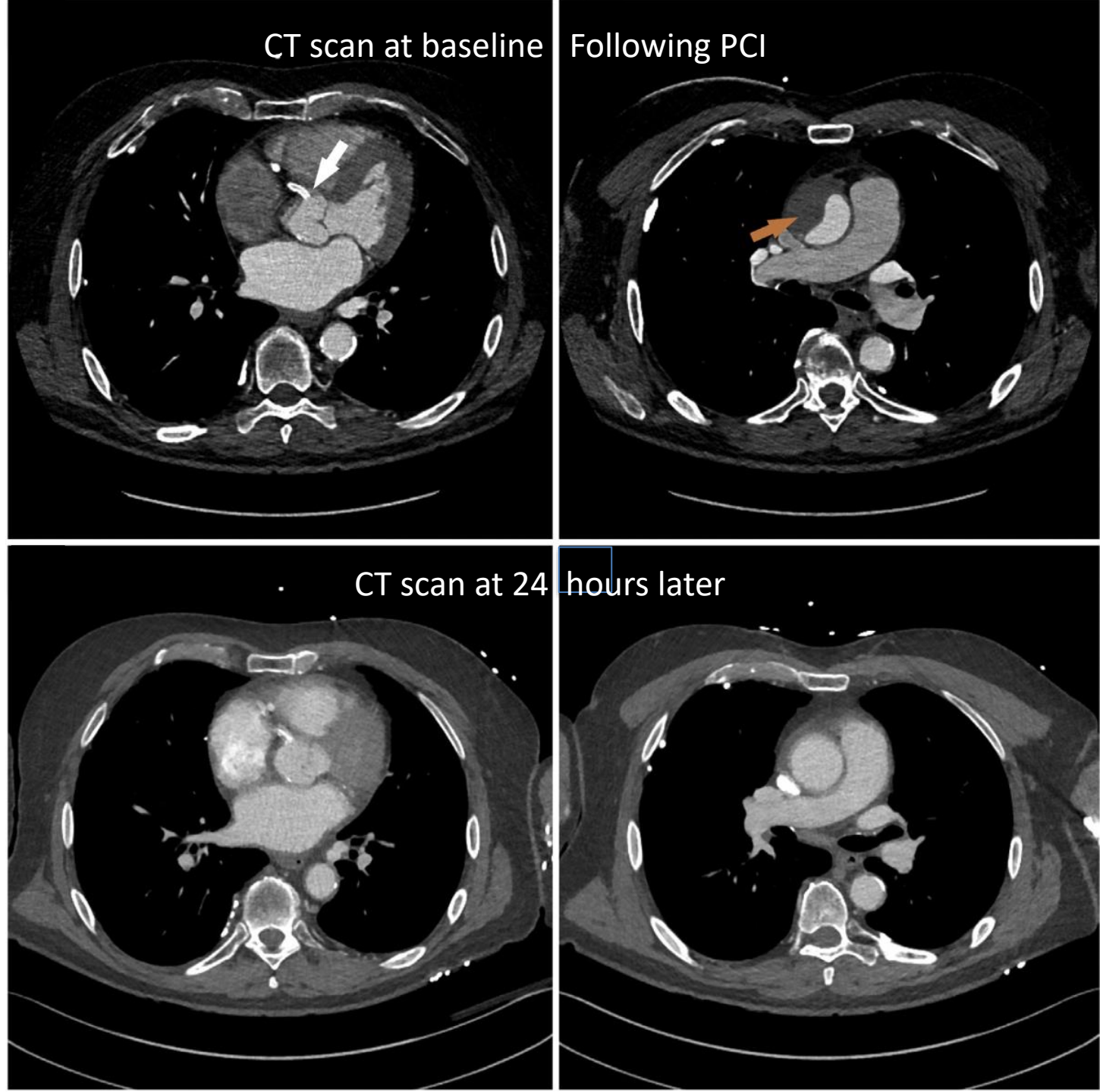


Iatrogenic Aortocoronary Dissection During Percutaneous Coronary Intervention

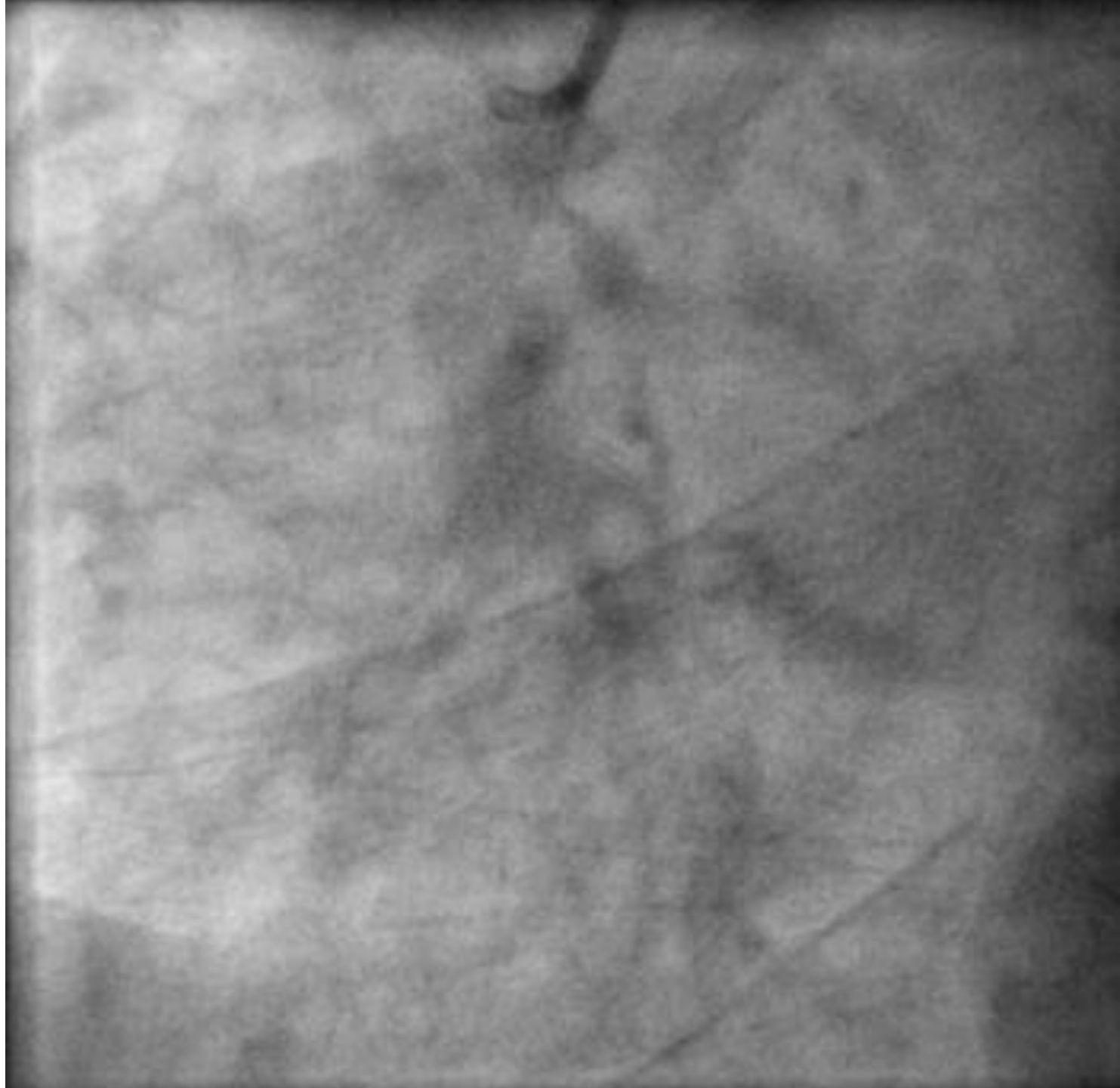
Investigation and Management

John Hung, MBCrB,^a Joel P. Giblett, MD, BM, BSc^{b,c} JACC: Case Reports 2021

Emerging evidence suggest that most iatrogenic aortic dissections can be managed conservatively in the absence of haemodynamic compromise

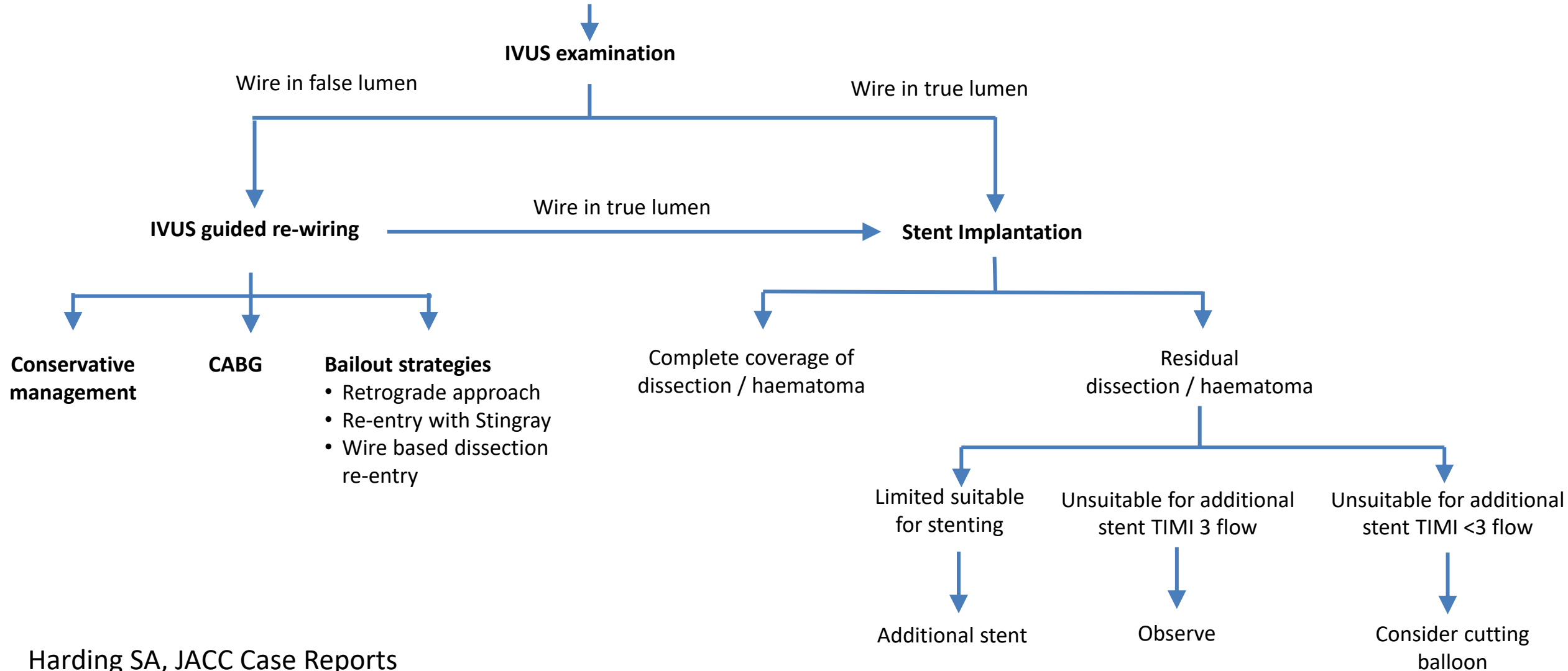


Major dissection of the donor artery

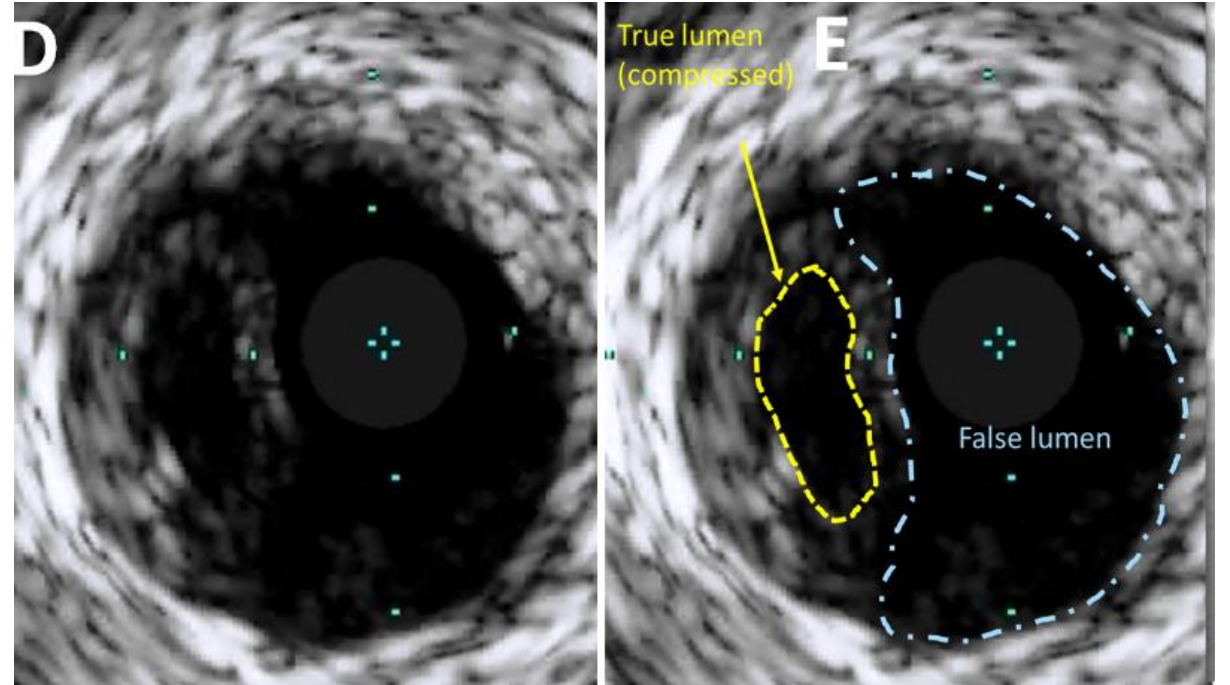
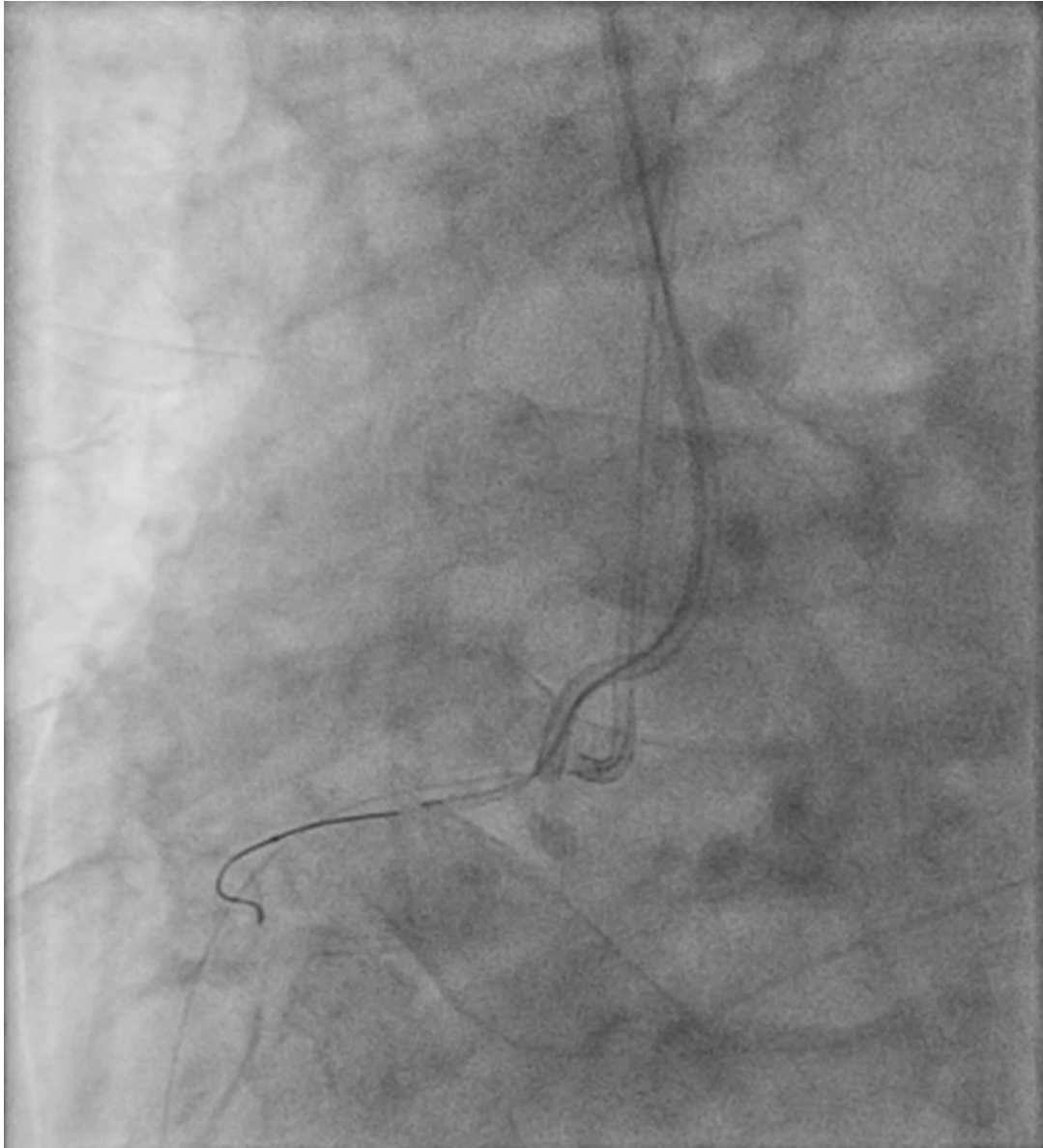


Iatrogenic coronary artery dissection

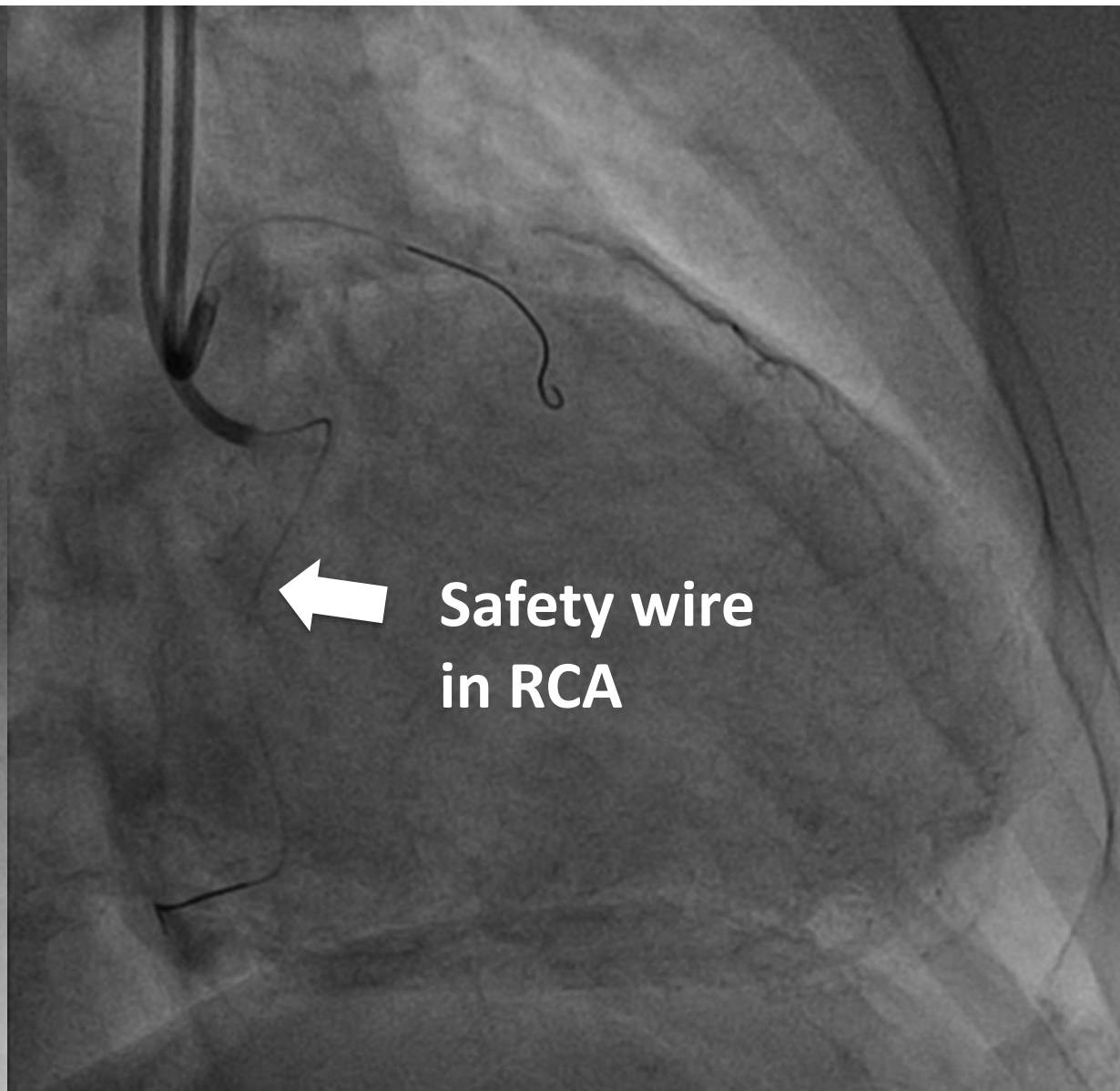
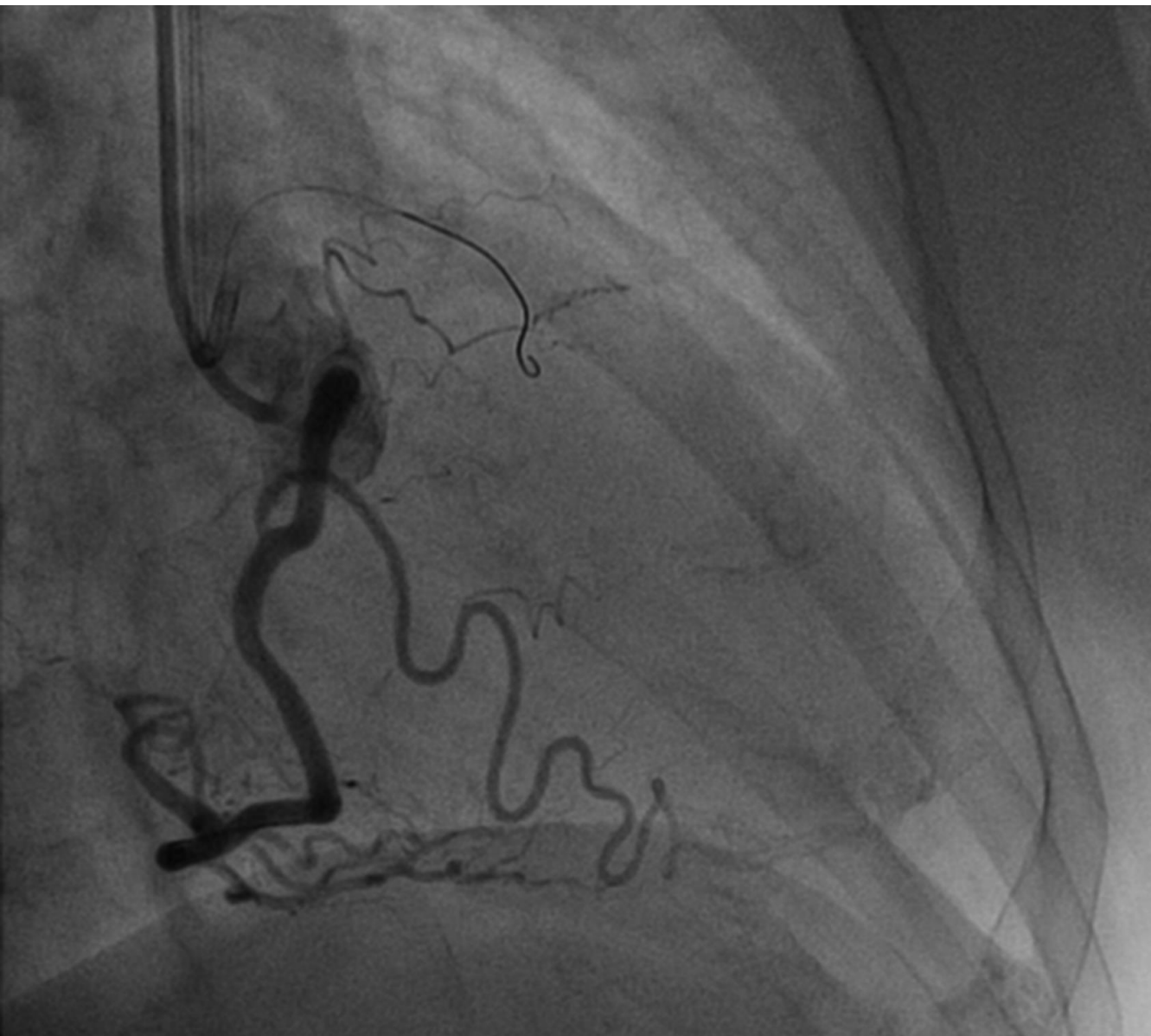
- **No further antegrade injection**
- Institute appropriate haemodynamic support
- Use a passive guide catheter that avoids deep engagement
- Attempt wiring of true lumen with a non-hydrophilic wire



Major dissection of the donor artery



Importance of a Safety Wire in the Donor Vessel

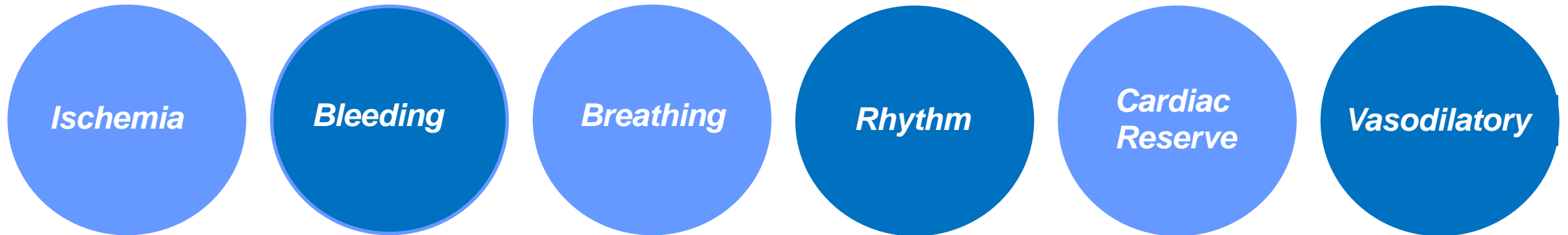


4. Hemodynamic collapse during CTO PCI



Hemodynamic Collapse: Your Checklist

Differential Diagnosis



Ischemia

Bleeding

Breathing

Rhythm

*Cardiac
Reserve*

Vasodilatory

*Guide dampening
Thrombosis
Dissection
Air embolism
Slow/No reflow
Intracoronary
equipment*

*Perforation
Vascular
Access*

*Airway
obstruction
Sedation*

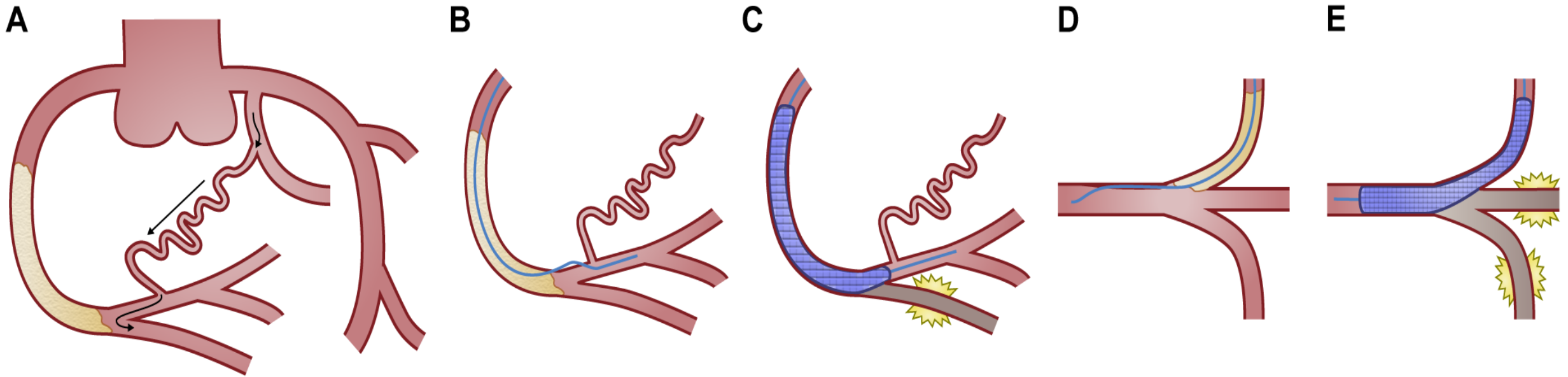
*Tachyarrhythmia
Bradyarrhythmia
AV block*

*Aortic
regurgitation
Mitral
regurgitation
Cardiogenic
shock*

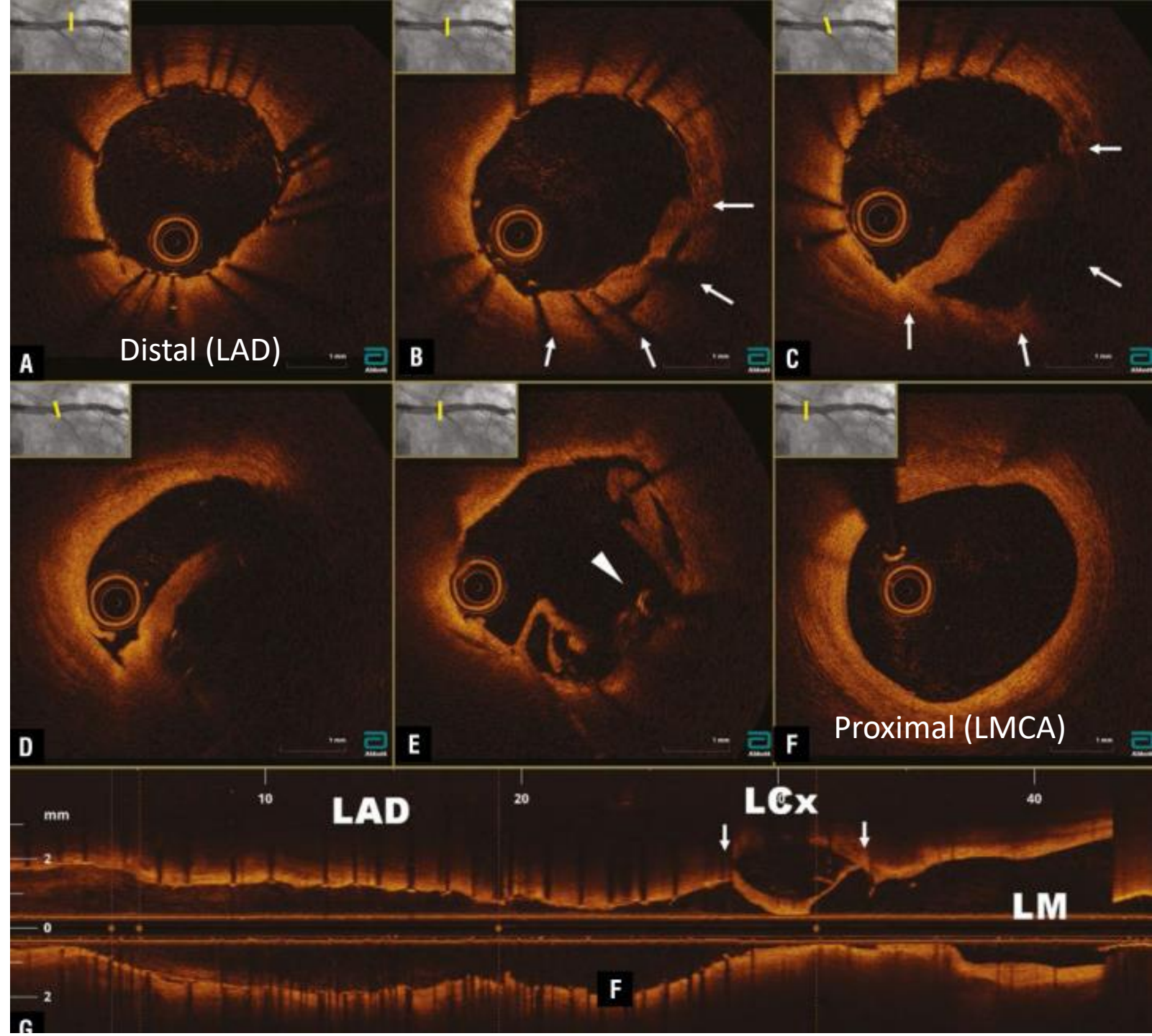
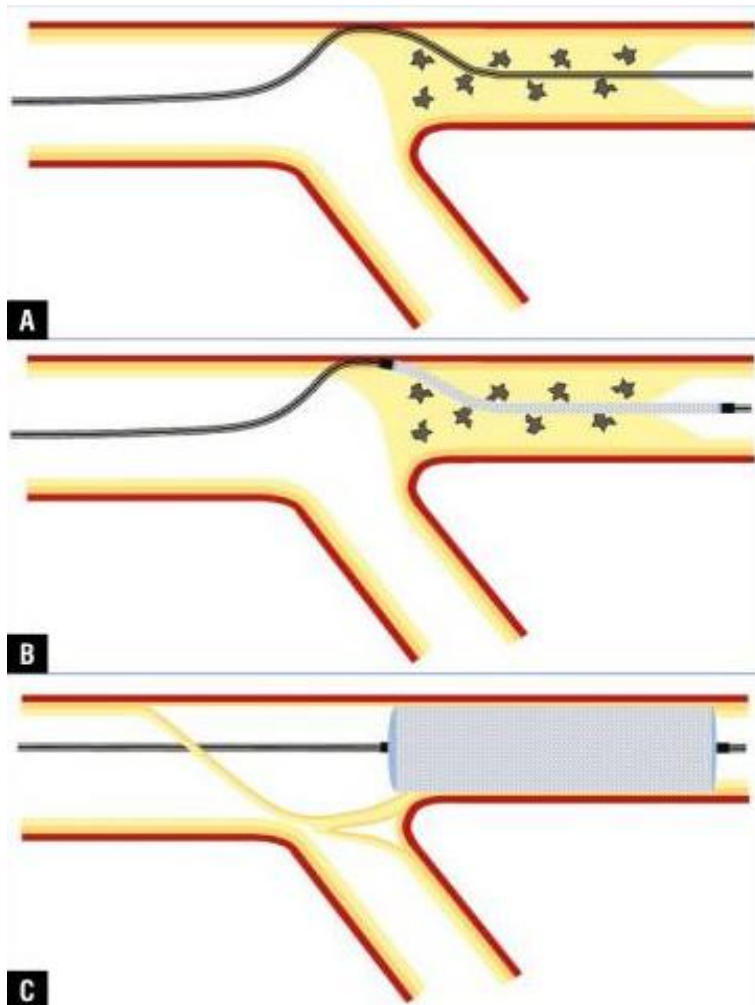
*Anaphylaxis
Sepsis*

Treatment Based on Primary Etiology of Hemodynamic Collapse

5. Side Branch Occlusion.



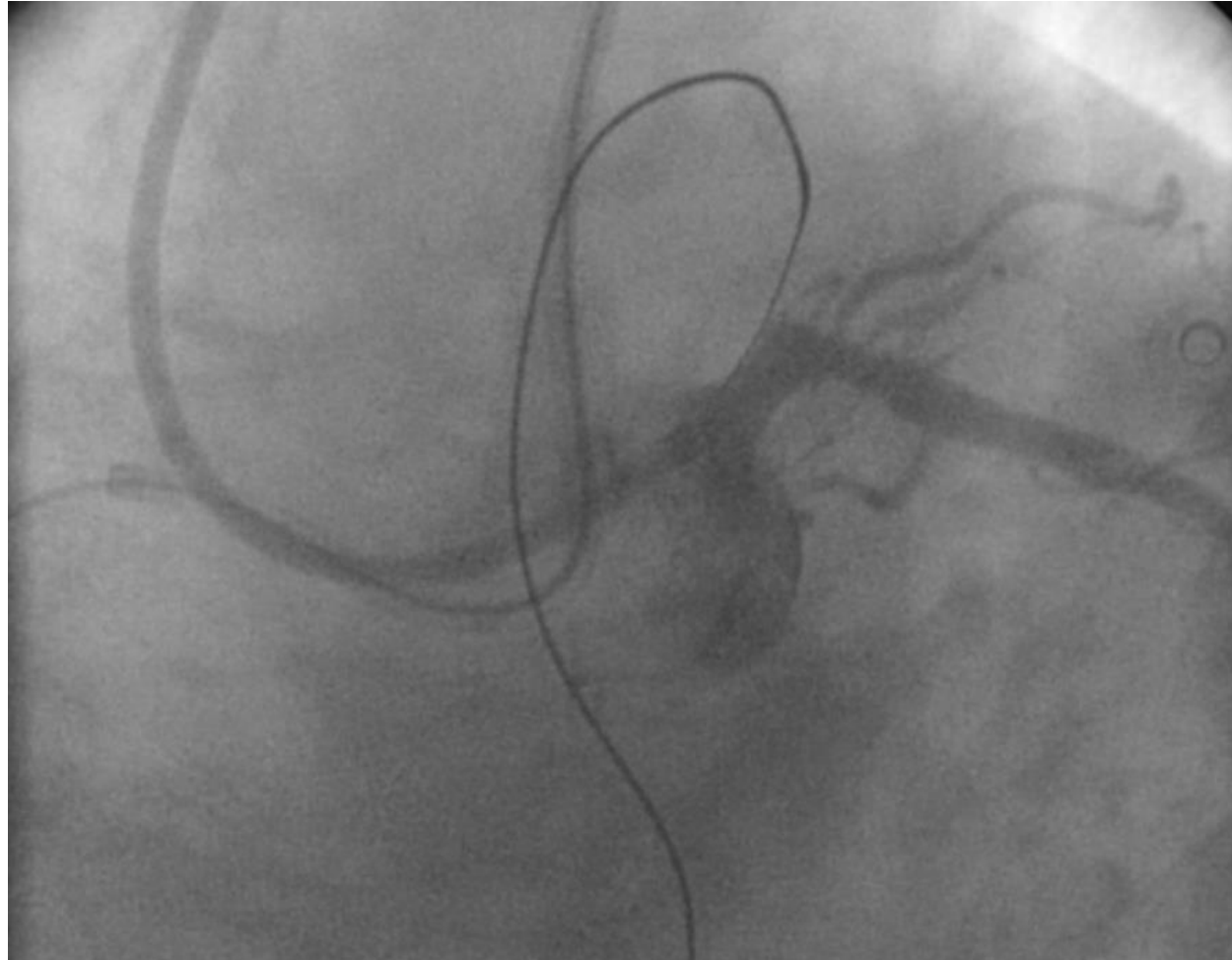
Subintimal carina shift



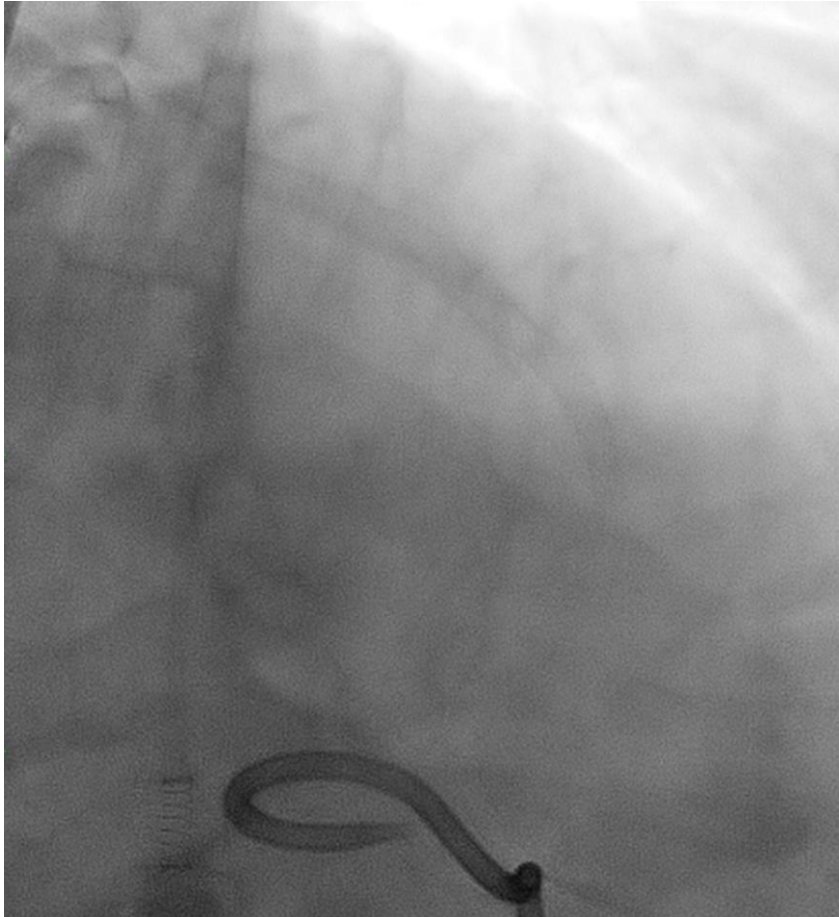
The Danger of Direct Retrograde Wiring



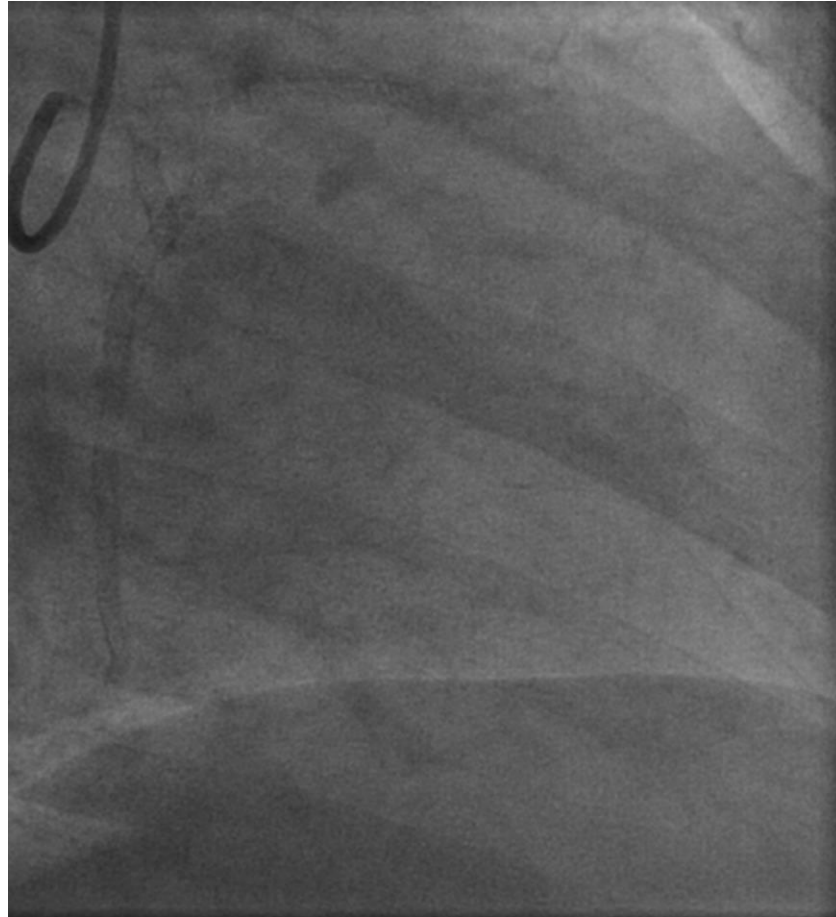
Subintimal retrograde wire path with direct retrograde wiring



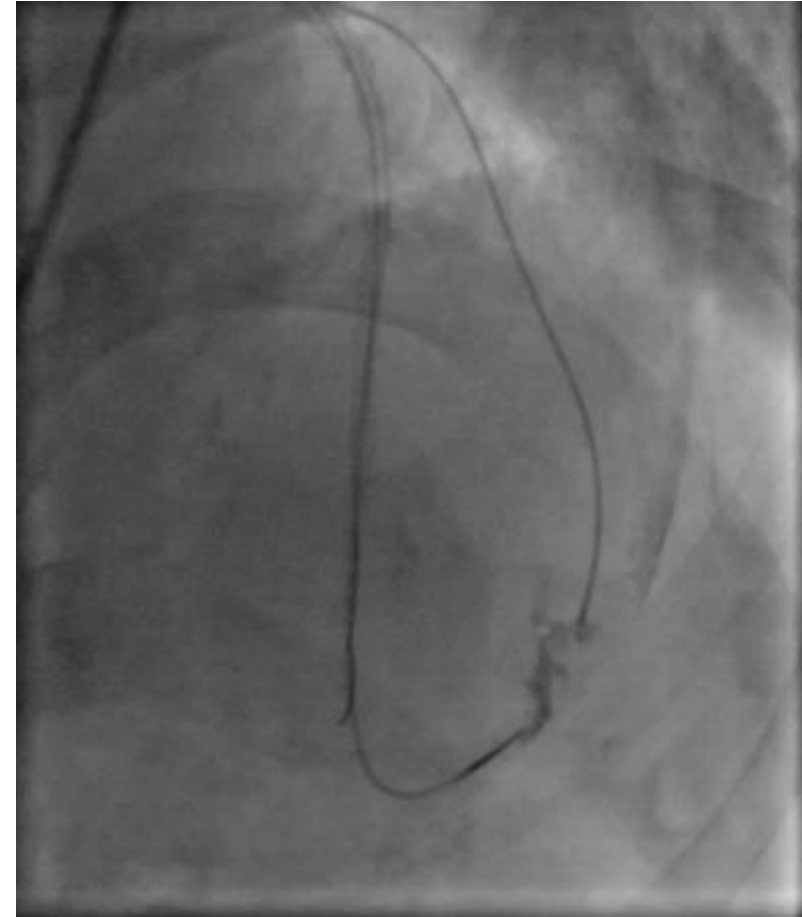
6. Perforations.



Main Vessel Perforations



Distal Perforations



Collateral Perforations

PROGRESS CTO Registry: Mortality

5/2012 to 12/2017

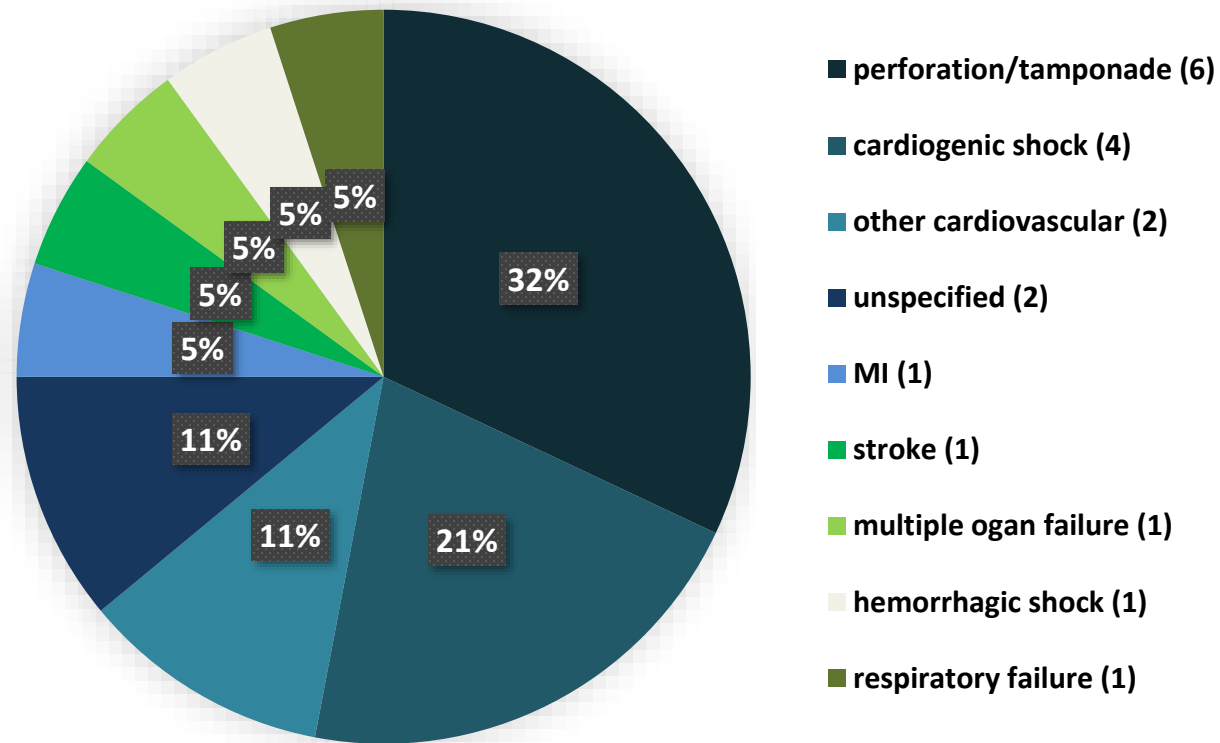
20 centers, 3,122 lesions in 3,055 patients

- MACE 3%
- Perforation 4%
- Equipment loss 0.2%
- Tamponade requiring pericardiocentesis 0.7%
- Vascular access complications 1.4%
- Bleeding 1%
- Dissection/thrombus of donor vessel 1%
- Aortocoronary dissection 0.1-0.2%

Definition: death, MI, recurrent symptoms requiring urgent revascularization with PCI or CABG, tamponade requiring either pericardiocentesis or surgery and stroke

PROGRESS CTO Registry: Mortality

Causes of death

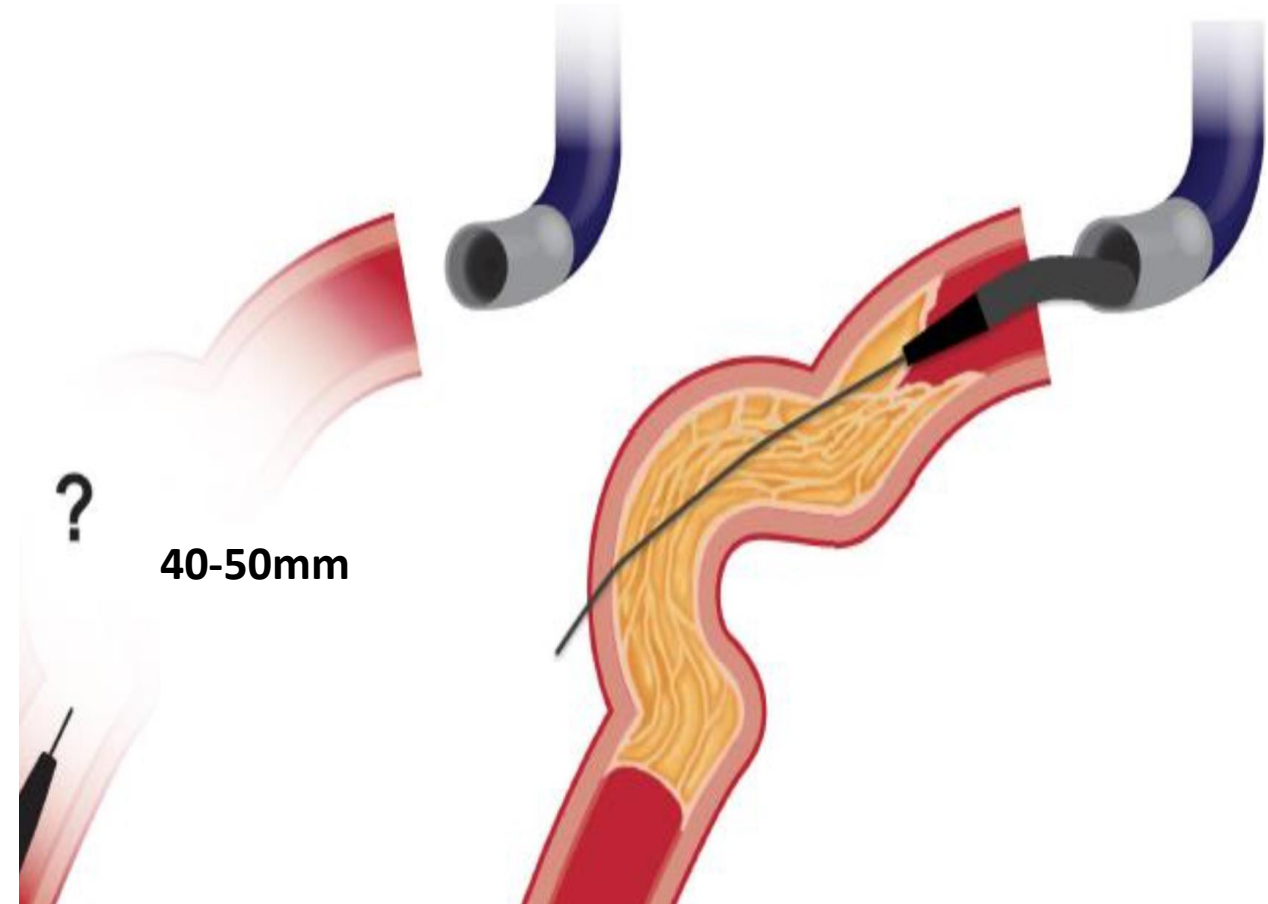
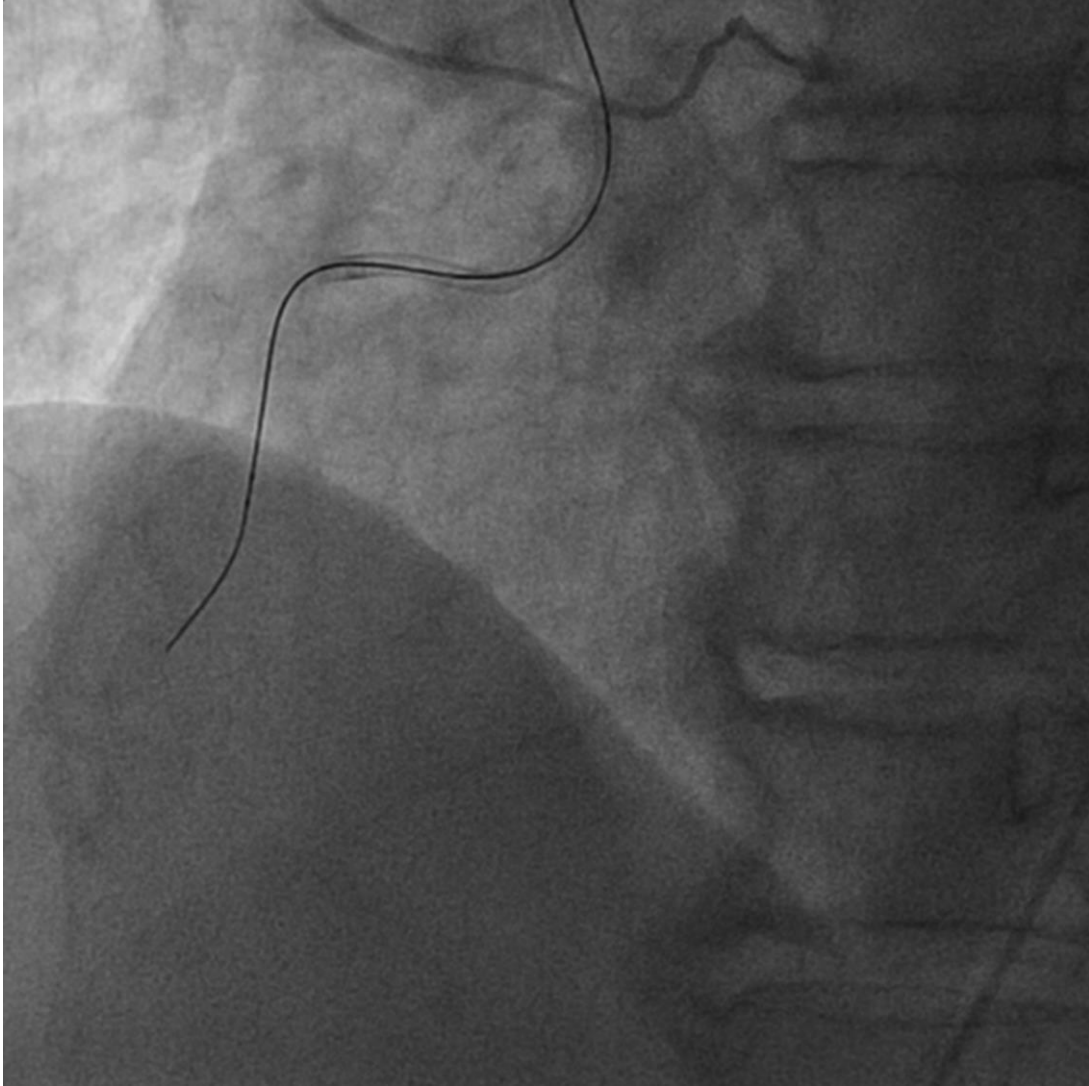


Mortality (0.8%)

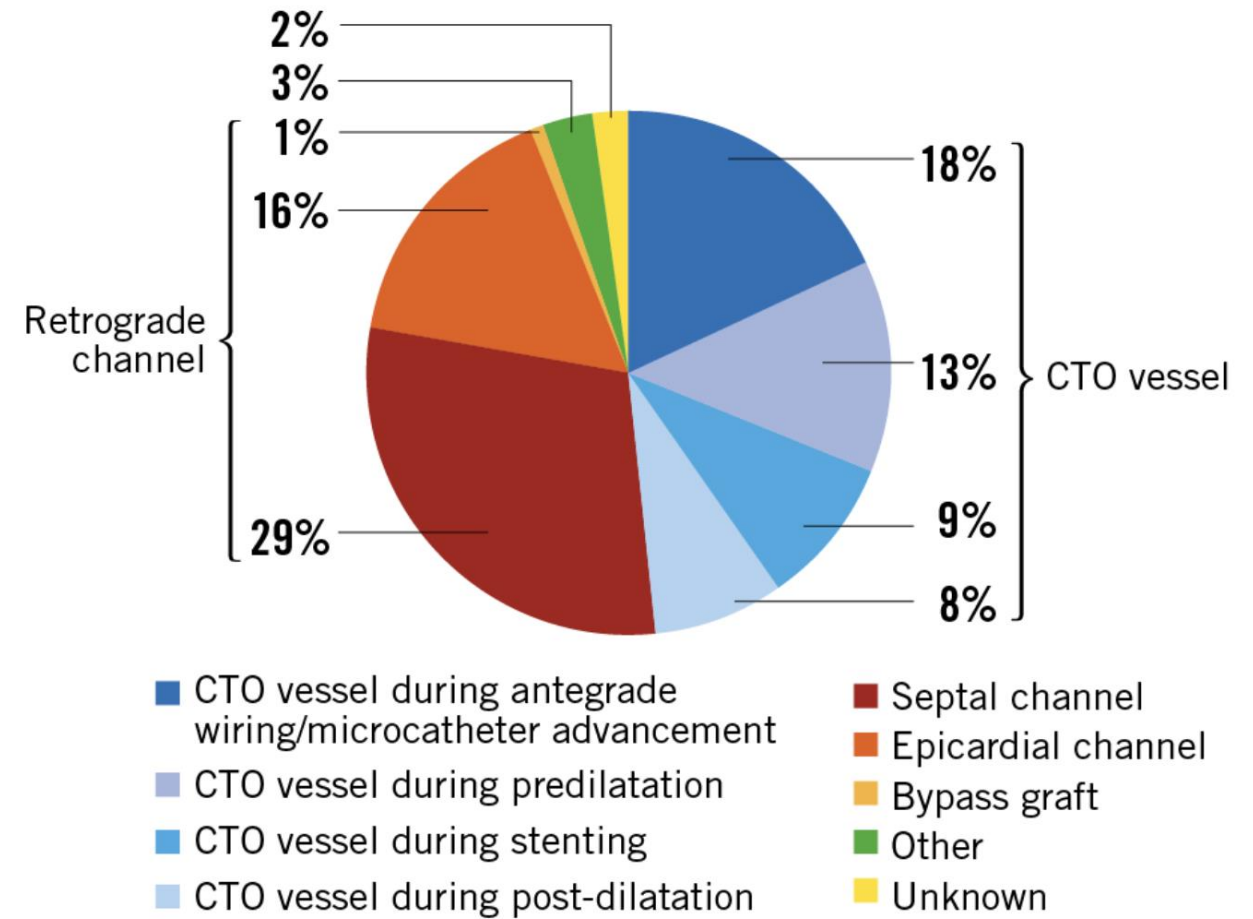
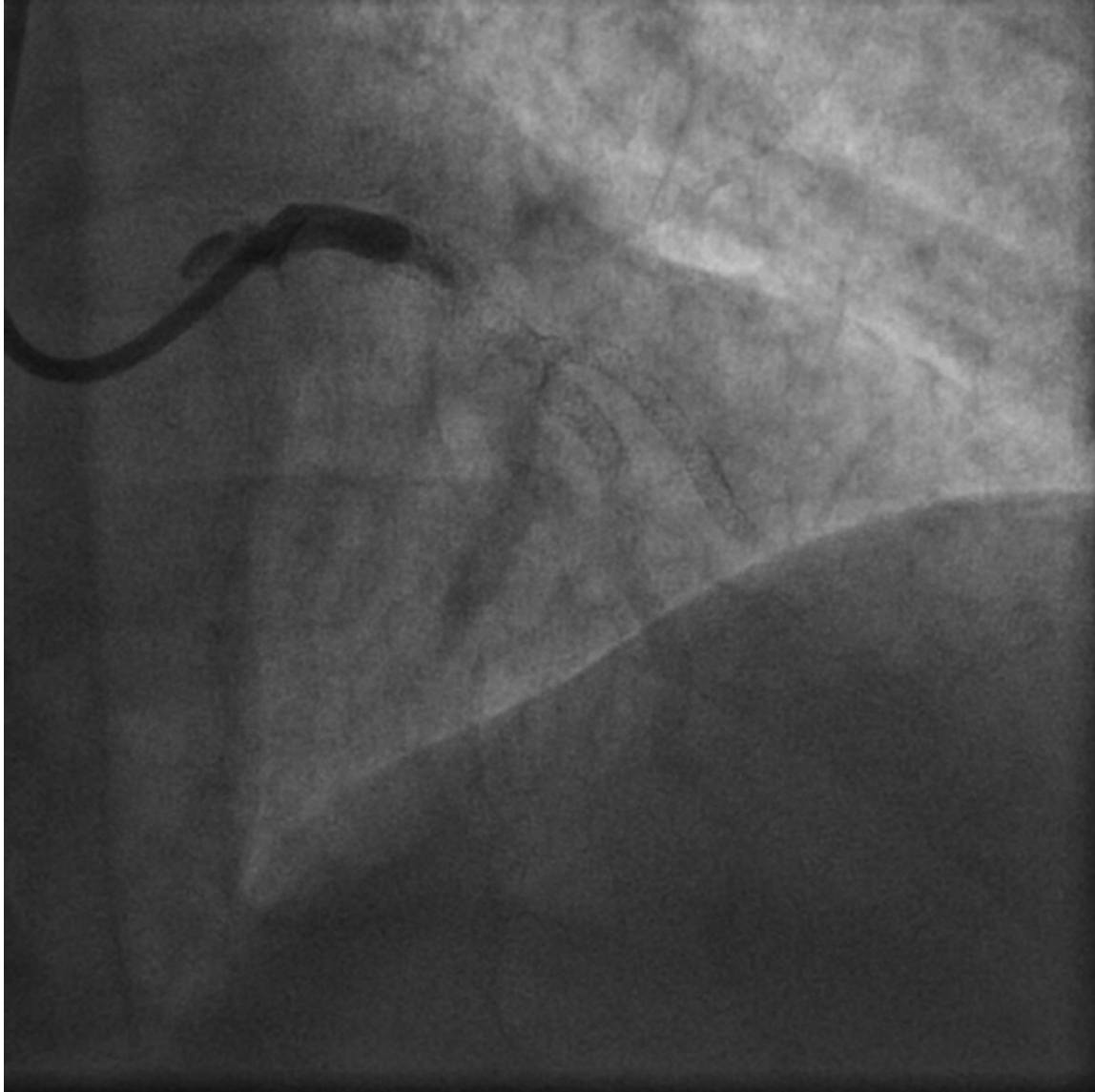


Most common cause of death is perforation/tamponade

Avoid High Penetration Force Wires in Ambiguous Anatomy

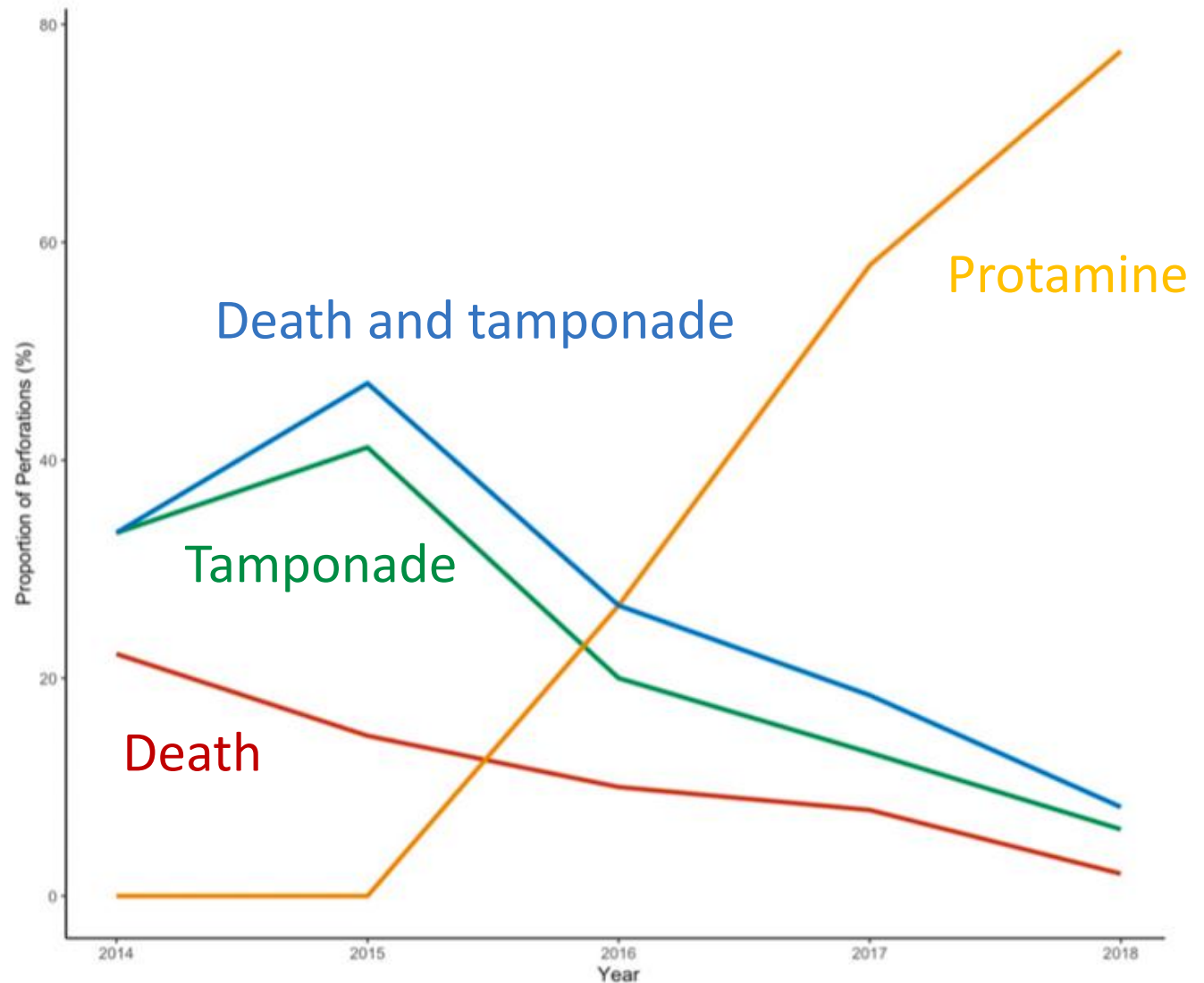


Avoid Use of High Risk Collaterals



Protamine is Your Friend

- UWMC 2014-2018
- 160 CTOs c/b perforation
- Protamine use: 0% → 78%
- Death: 22% → 2%
- No stent thrombosis



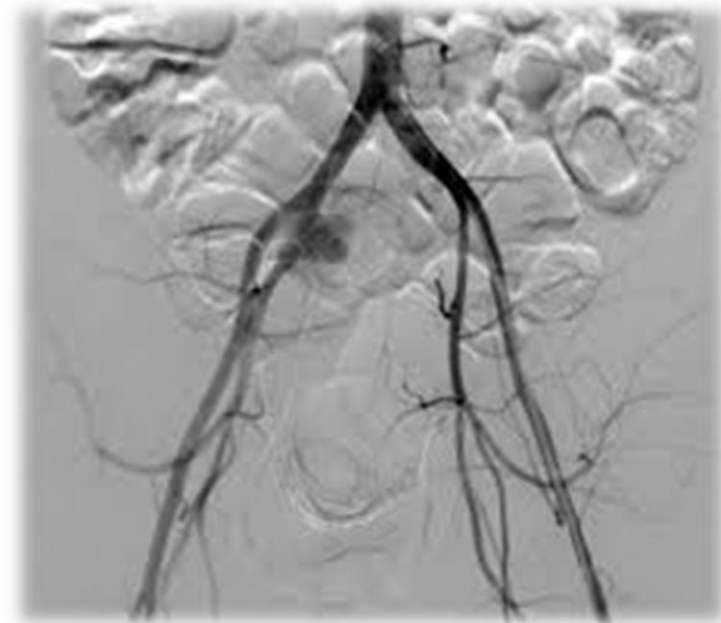
Protamine is Your Friend

- How
 - Get all equipment out first!
 - 25 mg over 5 min (to avoid hypotension)
- Myths
 - **Anaphylaxis**: 0.19% incidence based on systematic review of ~18,000 patients¹
 - **Stent thrombosis**: No large volume high-quality data to support the association (in patients on DAPT and not having ACS!)

¹Levy JH. Anesth Analg 2008;106:392-403.

8. Vascular Access

- Biradial
- USS guided femoral access
- Micropuncture set
- Final cross over angiography
- USS to confirm closure



9. Contrast-induced acute kidney injury.

Reducing contrast toxicity:

- Hydration
- Discontinuation of nephrotoxic medications
- Avoid hypotension

Reducing contrast volume:

Keep contrast volume to $<3x$ eGFR and ideally $<2x$ eGFR

Contrast volume can be reduced by:

- Careful analysis of previous angiograms / CT
- Optimal timing of the antegrade contrast injection to coincide with maximal retrograde filling
- Microcatheter tip injections both antegrade and retrograde (through the most dominant collateral)
- Use of the retrograde approach
- Use of biplane
- Use of IVUS.

10. Radiation Injury.

- **A) Radiation injury in CTO PCI. <5 Gy**
- **B) Prevention.**
 - **i) Reduce total radiation dose.**
 - low magnification and collimation, using ≤ 7.5 frame per second fluoroscopy, avoiding steep angles, using the fluoroscopy store function instead of cine angiography, avoidance of panning. using the trapping technique for device exchanges, using a marker torquer on wires, Some X-ray systems stop imaging when the operator's eyes are not looking at the screen reducing unnecessary fluoroscopy radiation.
 - **ii) Reduce radiation concentration.**
 - Some angiography machines software to display skin dosage information, Disposable radiation shields (such as the Radpad)
- **C. Patient follow up.**
 - Patient who receives high radiation dose (> 5 Gy) should receive patient information sheets, followed by clinical examination and photography after 30 days.

11 When to Stop

Consider stopping :

- >3 hours
- 3x estimate
- A...

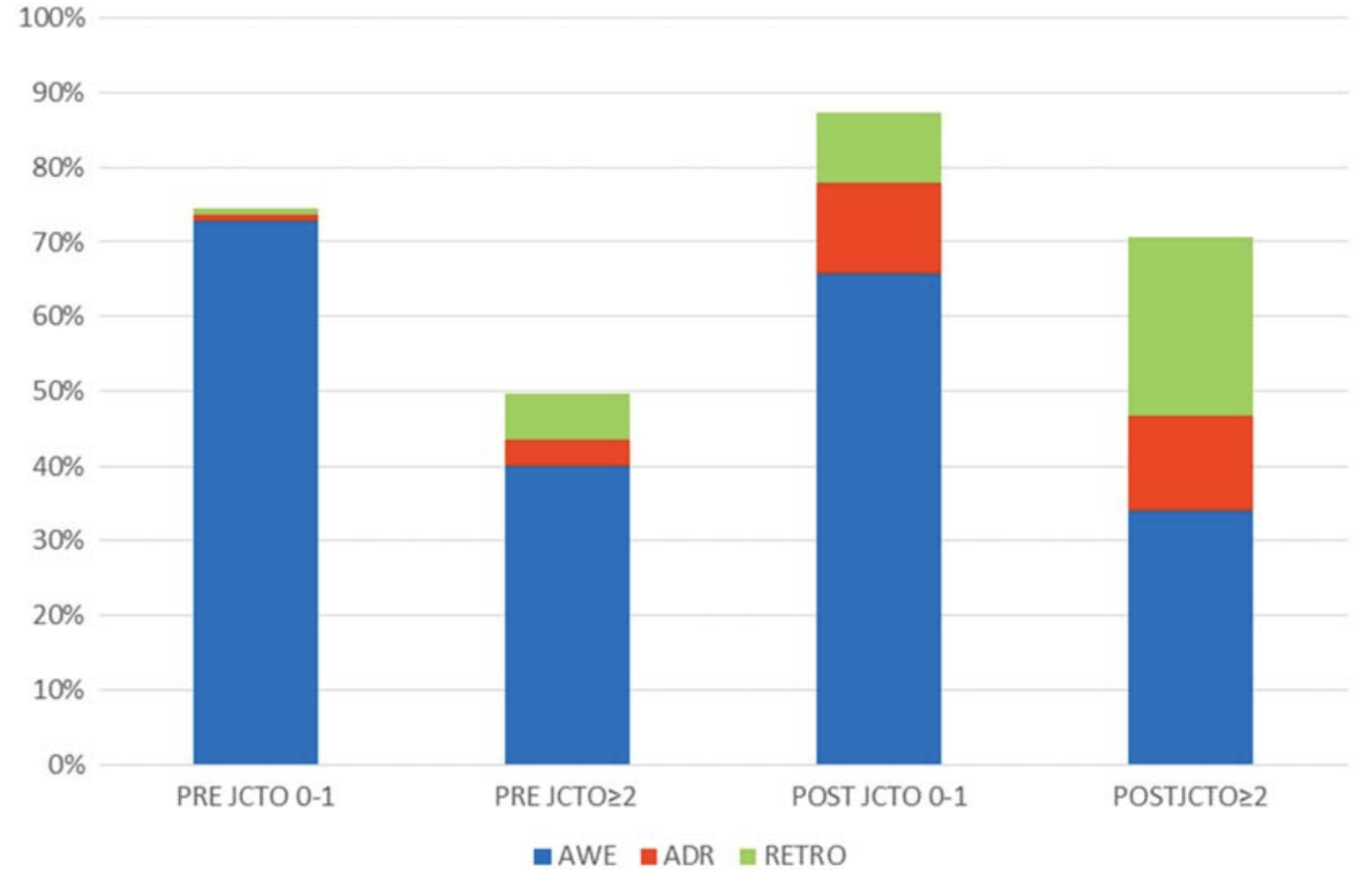
Consider Investment procedure

... consider stopping:

- Operator experience
- Operator fatigue

12. Proctoring

Proctoring improves success and safety



Conclusions:

Before

Know what can go wrong – what causes it – and how to fix it

Study the angiogram and the patient

During

Do not do risky things (unless potential benefit > risk)

Early detection and Rx of complications

Have an algorithmic approach to complications

After

Reflect: What did I learn?

How can we do better next time?