How to avoid & management of CTO complication

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Key point

- Understanding CTO complication
- How to avoid → Prevention
- How to management → Treatment

Background

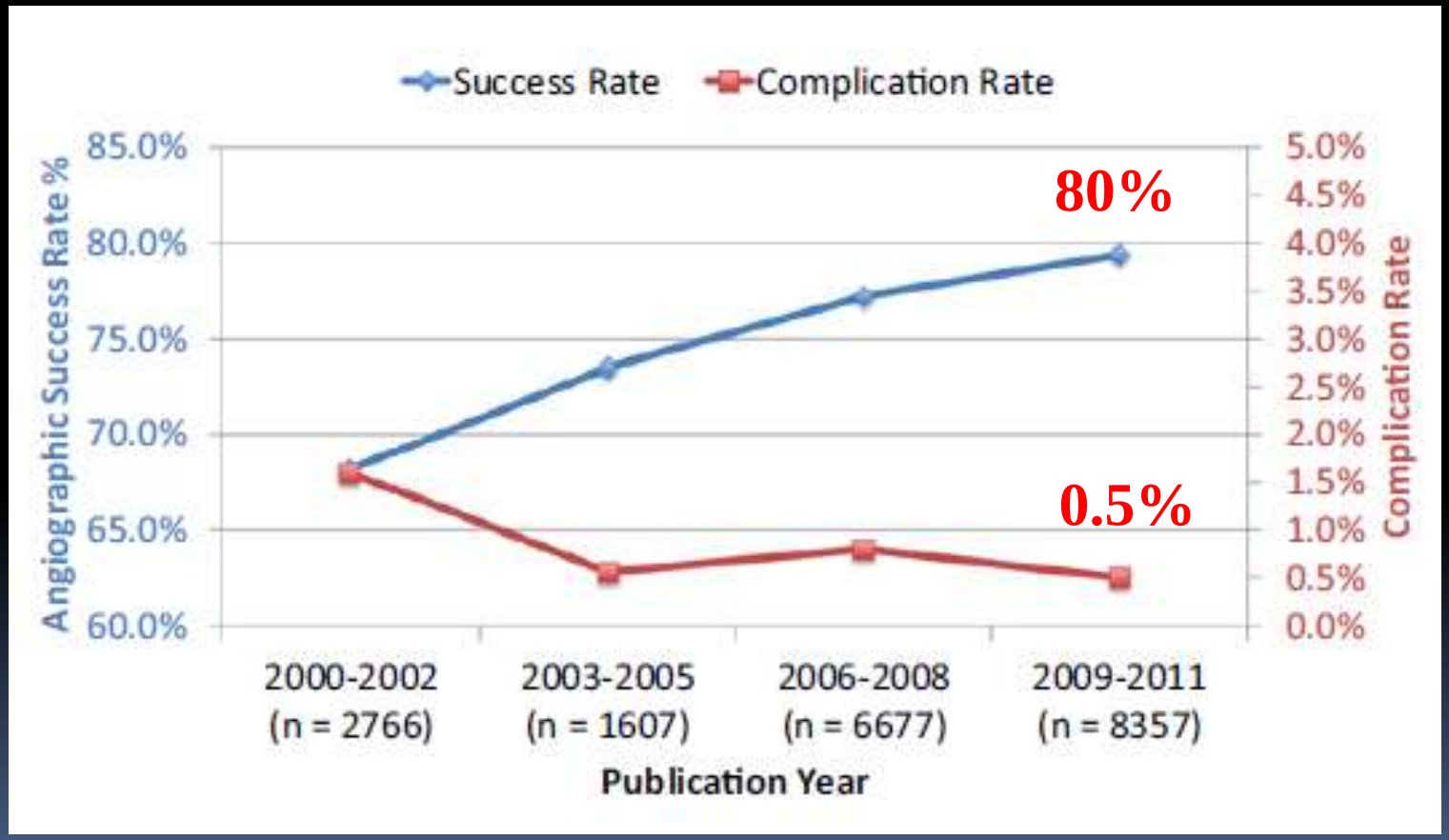
Complication of CTO intervention

PCI of a CTO has traditionally and mistakenly been considered a low-risk procedure despite the fact that in-hospital major adverse event (death, MI, emergent CABG) rates may exceed 5%.

	CTO Angioplasty (n=2007)	Non-CTO Angioplasty (n=2007)	*P*
Death	1.3%	0.8%	0.13
Q-wave myocardial infarction	0.5%	0.6%	0.67
Non–Q-wave myocardial infarction	1.9%	2.4%	0.27
Urgent bypass graft surgery	0.7%	1.1%	0.25
Urgent repeated PCI	1.5%	2.0%	0.23
Major adverse cardiac events	3.8%	3.7%	0.39
Stroke	0.01%	0.1%	0.63
Vascular complication	1.7%	2.5%	0.80

Background

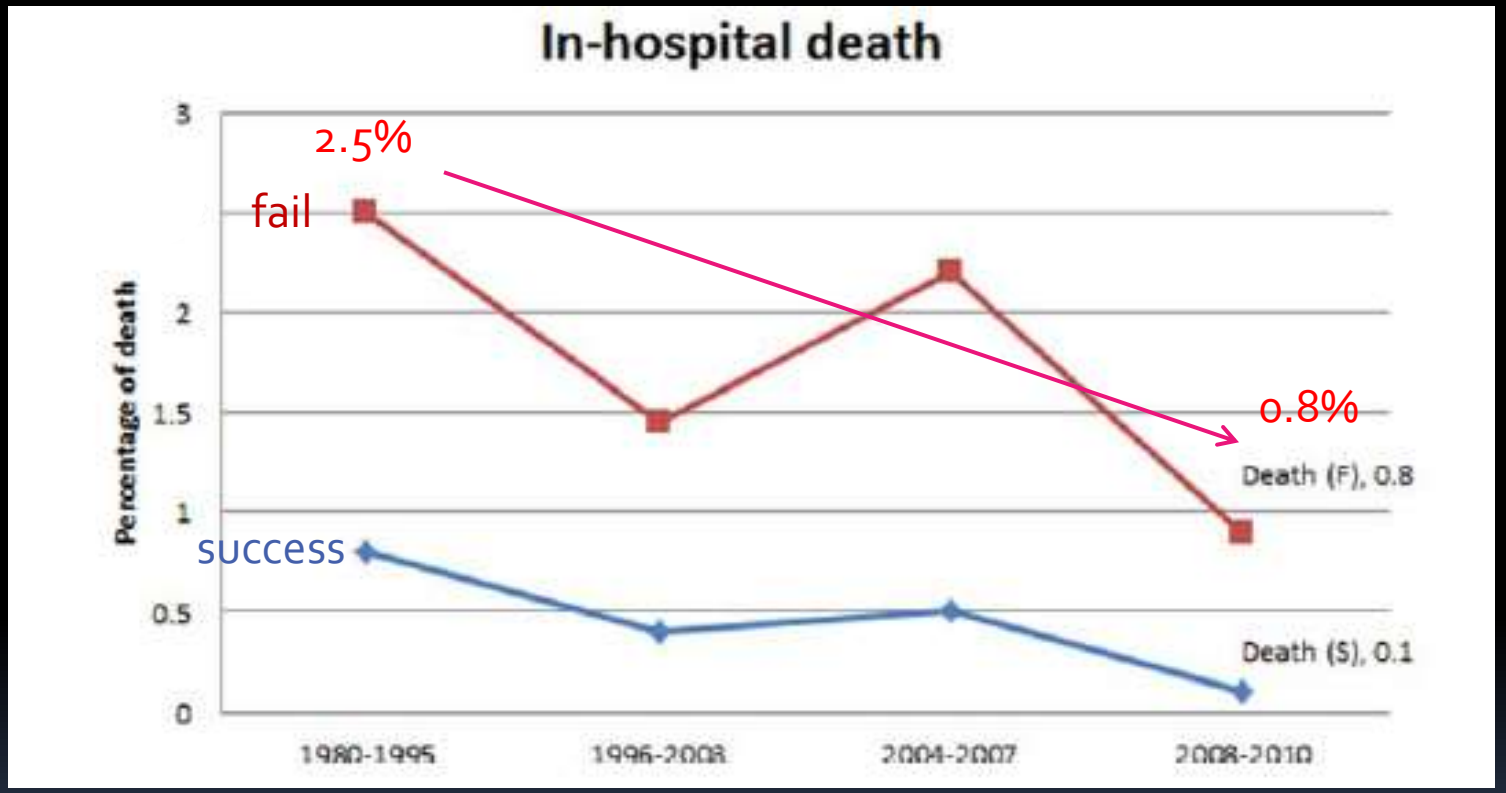
Why important complication of CTO intervention ?



Patel VG et al. J Am Coll Cardiol Intv 2013;6:128–36

Background

In-hospital mortality in CTO failed patients



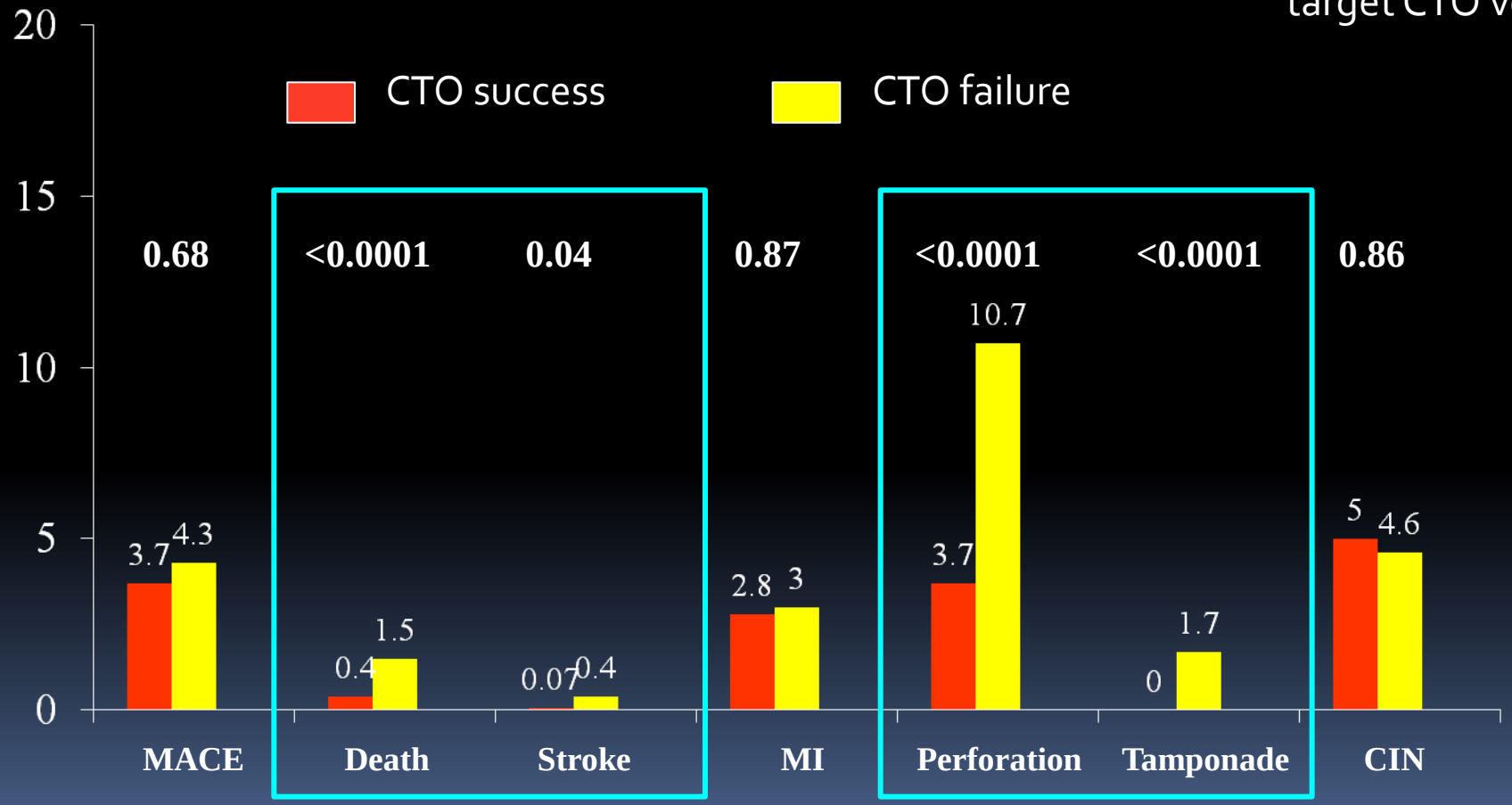
Important point !

→ Decreased mortality from 2.5% to 0.8%

→ As ever, **8 times** higher mortality in CTO failed patients!

CTO - PCI : Complication rate

-65 studies with 18,061 patients and 18,941 target CTO vessels



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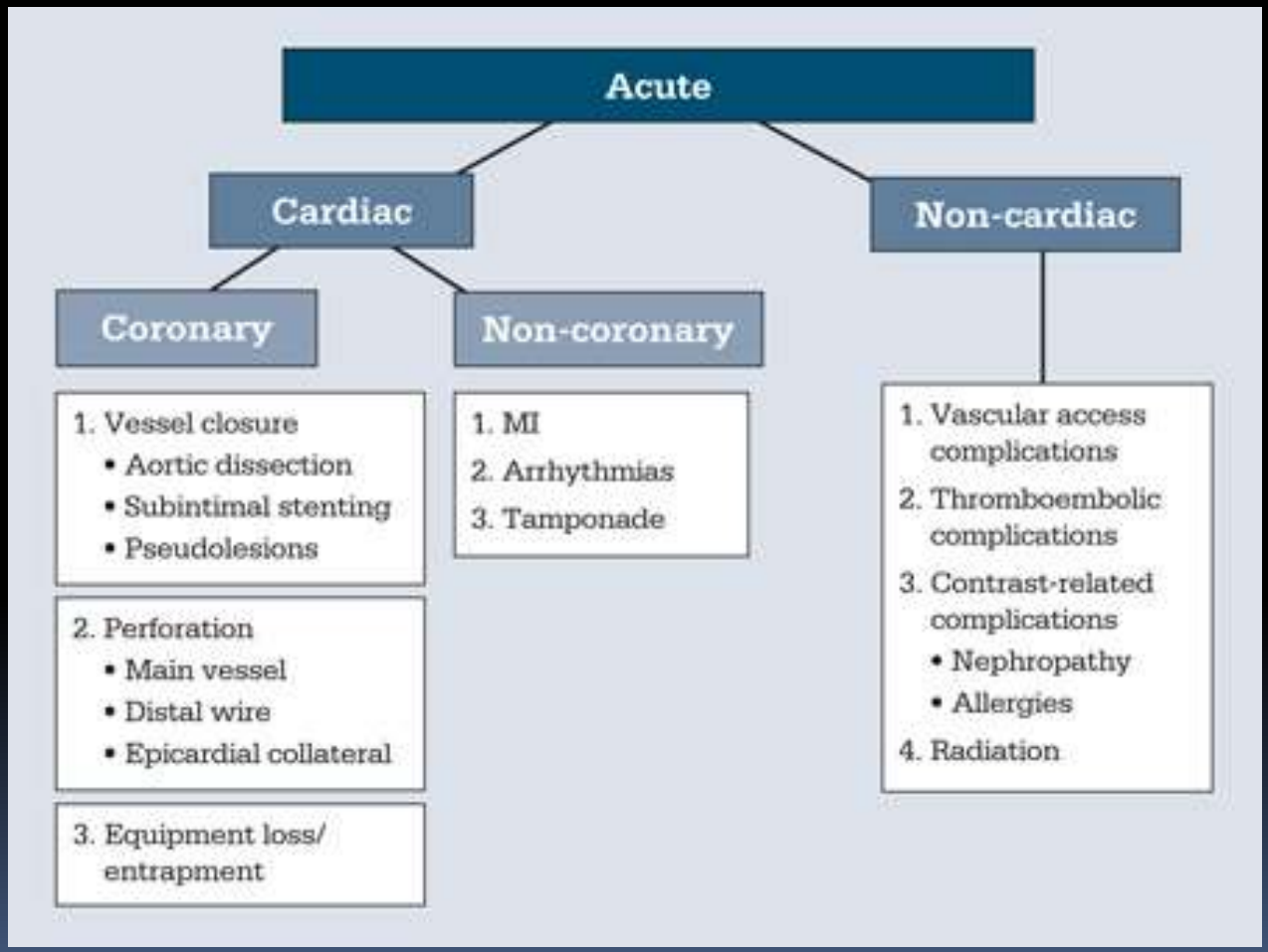
Background

Causes of complication (CTO intervention)

- Aggressive using of stiff and sharp Guide wire
- Using the various accessory device and
  long procedure time
- Lesions the organization of complex and irregular
- Extensive contrast use and radiation exposure

Background

Classification of complications of CTO interventions



Cardiology Today's Intervention, September/October 2013

Emmanouil S. Brilakis, MD, PhD

Classification of complications of CTO interventions

- **General complication**

1. Radiation
2. Contrast - related complications
3. Thrombus trouble

- **CTO-intervention related complication**

4. Perforation
   - Wire perforation intra-CTO & distal coronary
   - Device perforation intra-CTO (stent & balloon)
   - Retrograde channel perforation

5. Equipment loss / entrapment

General complication

- **Radiation**

  → Check fluoro time, Air karma data (Gy)

  (5 Gy ↑ : observe closely, 15 Gy ↑ : stop procedure)

  → Dermatologist care, transplantation

- **Contrast - related complications (Renal dysfunction)**

  → Check used contrast, hydration

  → Option : mixed dye , retrograde approach,

  minimum contrast injection

- **Thrombus trouble**

  → ACT check (every 30 minutes after heparin injection)

  : 300sec ↑

Perforation

Classification according to coronary perforation severity grade

Class	Definition	Risk of tamponade
Class I	Extraluminal crater without extravasation	8 %
Class II	Pericardial or myocardial blush without contrast jet extravasation	13 %
Class III	Extravasation through a frank (≥1mm) perforation or cavity spilling into an anatomic cavity chamber	
	A : Directed toward the pericardium	63 %
	B : Cavity spilling into coronary sinus, myocardium etc	0 %

In 1994, Ellis et al

Wire perforation intra-CTO & distal coronary

- **Prevent**
  → Vary difficult, be careful !!

- **Treatment**

1) Intra CTO
→ Sealing With plaque
→ Prolonged balloon or Graft stent

2) Distal coronary
→ coiling
→ Embolization using fat, gelform

Device perforation intra-CTO (stent & balloon)

→ **Risk factor of coronary perforation (by Balloon, stent)**

- Oversizing balloon (balloon-artery ratio > 1.2)
- High-pressure balloon inflation outside the stent
- Stenting of tapering vessel
- Stenting of contained perforations from other device
- Stenting of lesions that are recrossed after severe dissection or abrupt closure
- Stenting of total occlusion when there has been unrecognized subintimal passage of the wire
- Stenting of small vessels (<2.5mm)

Device perforation intra-CTO (stent & balloon)

- **Prevent**
  - → An accurate assessment of angiogram
  - → checked IVUS perforation high risk sign

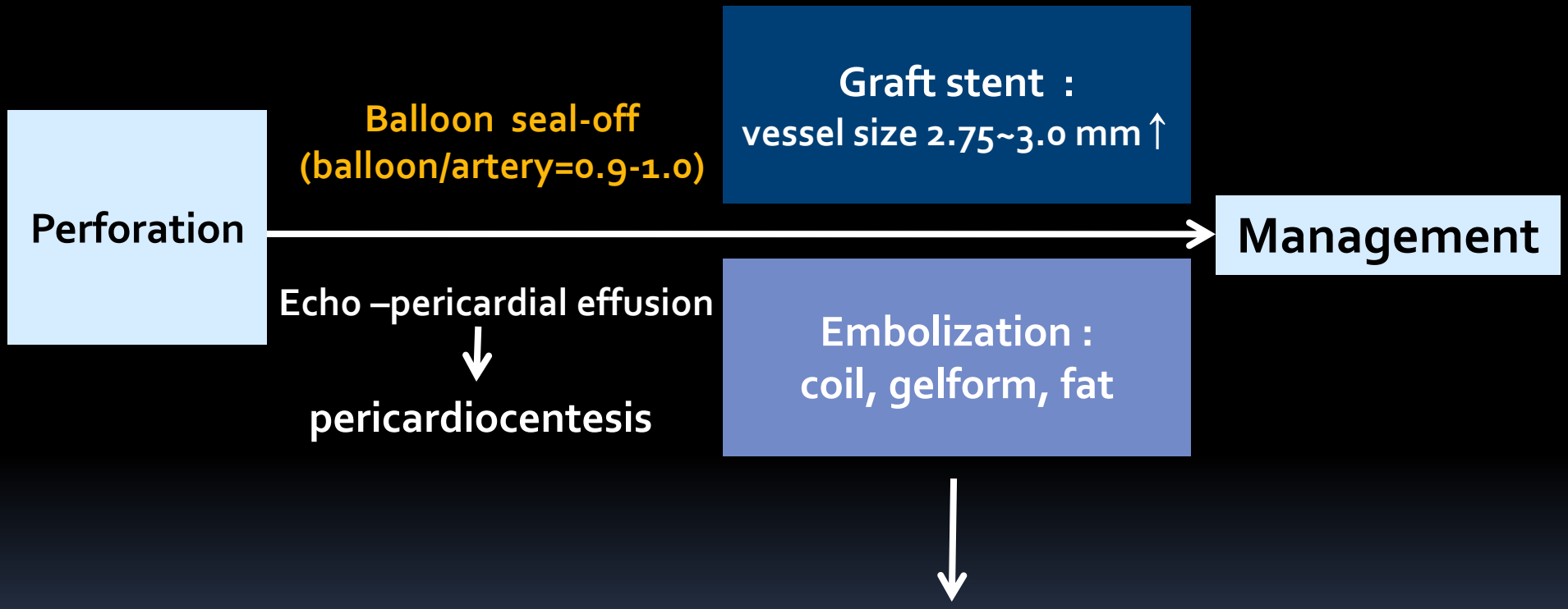
- **Treatment**
  - → Prolonged ballooning (balloon/artery=0.9-1.0)
  - → Graft stent

Retrograde channel perforation

- **Prevent**
  - → Not to be optimistic
  - → Careful angiographic assessment
  - → When necessary selective angiogram

- **Treatment**
  - → Septal channel : leaving in almost all case
  - → Epicardial channel : coiling

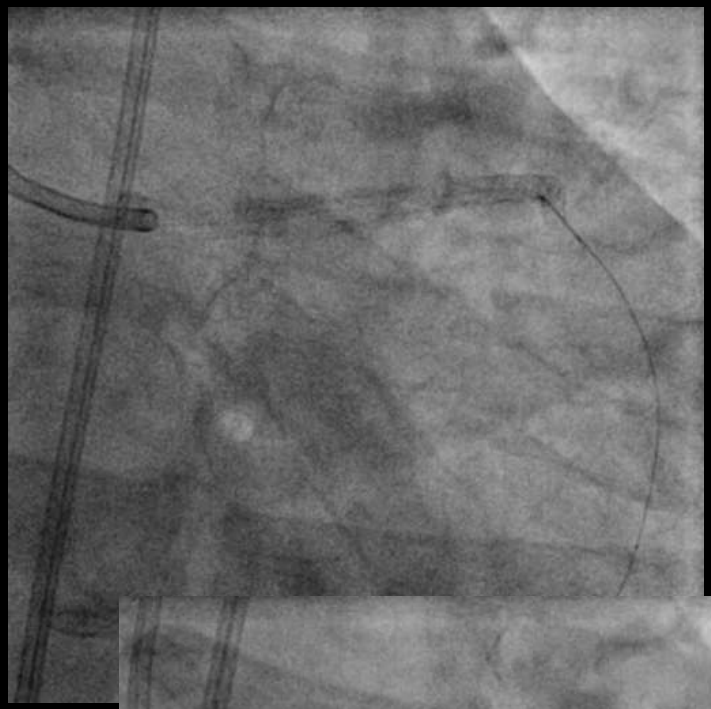
Schema of Perforation management

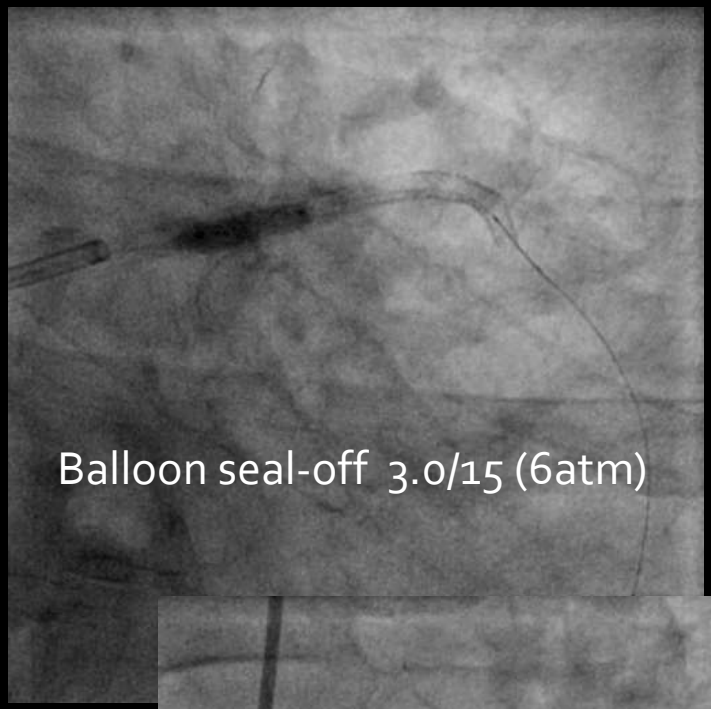


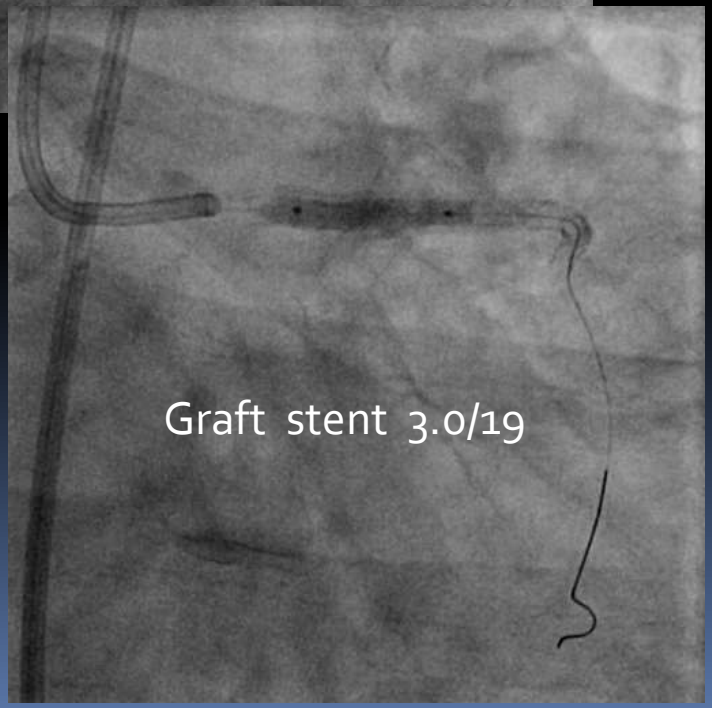
* In some case, consider collateral vessel embolization
(Distal coronary , Epicardial collateral)

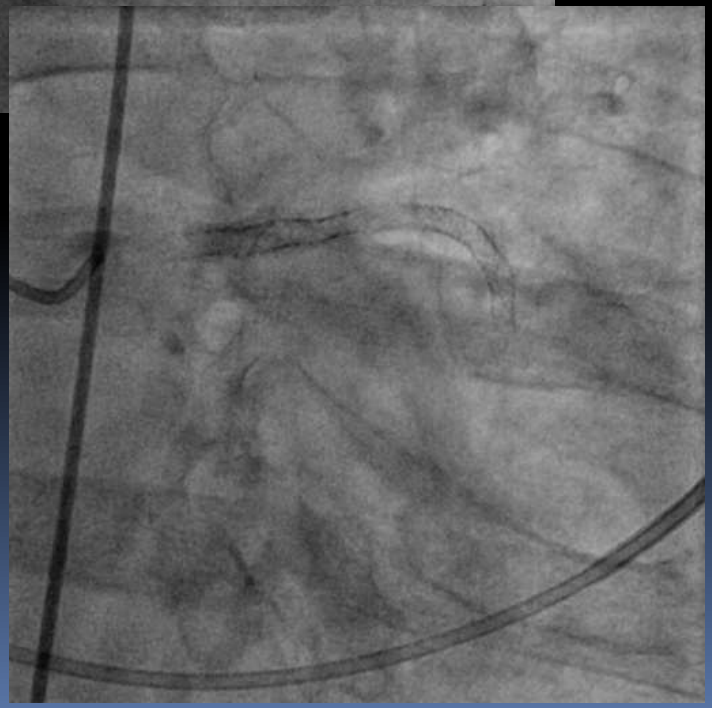
Case –Distal coronary perforation (coiling)

Case – Device perforation (graft stent)









Equipment loss / entrapment

1. Stent loss (or entrapment)

1. Wire fragment loss (or entrapment)

Stent loss (or entrapment) - Incidence

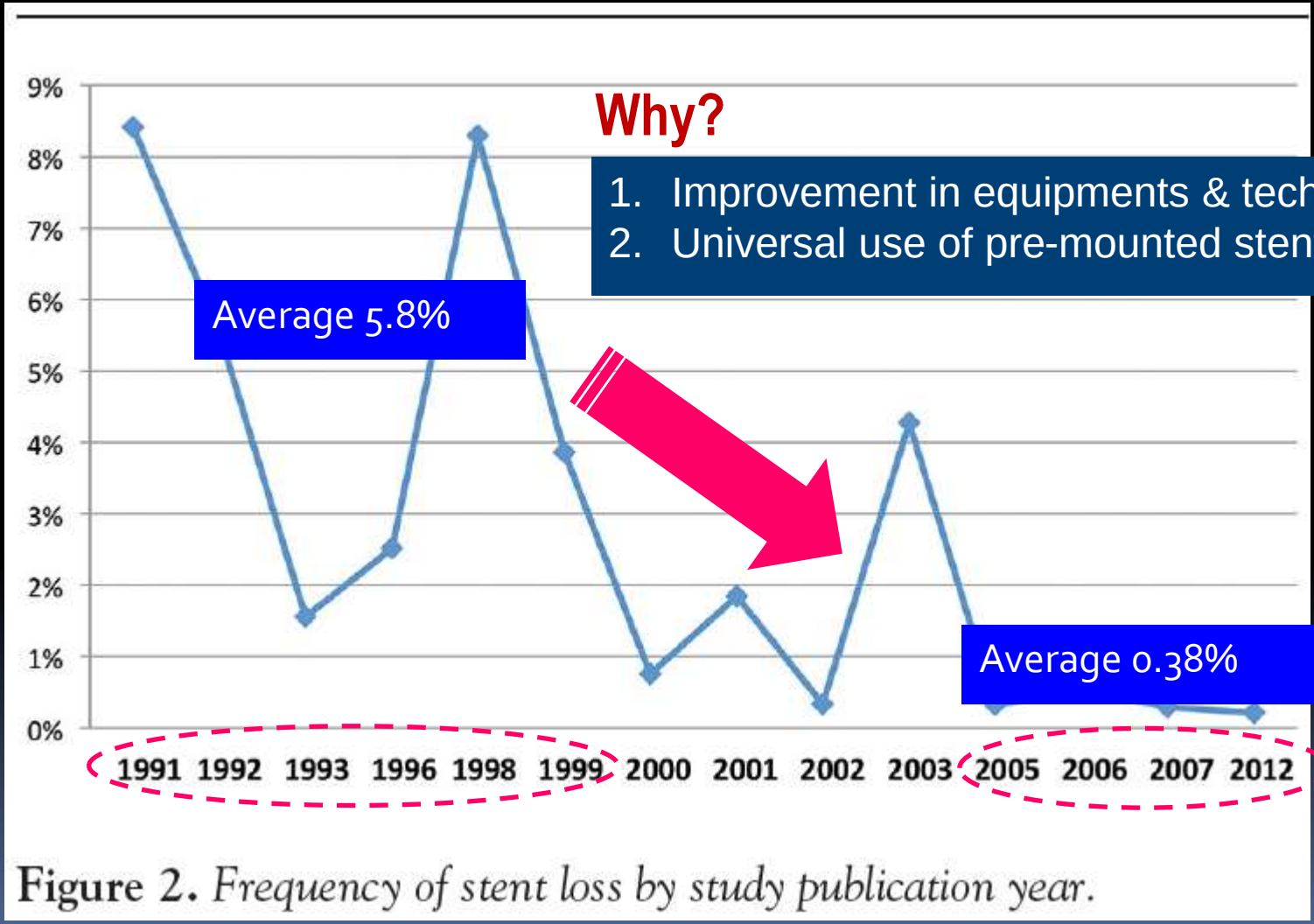


Figure 2. *Frequency of stent loss by study publication year.*

J Invasive Cardiol 2013;25(12):637–641

Stent Loss : Risk Factor

- Arterial tortuosity
- Severe target vessel calcification
- Direct stent implantation
- Poor guide support
- RCA, LCX > LAD
- Hand crimped > pre-mounted stent

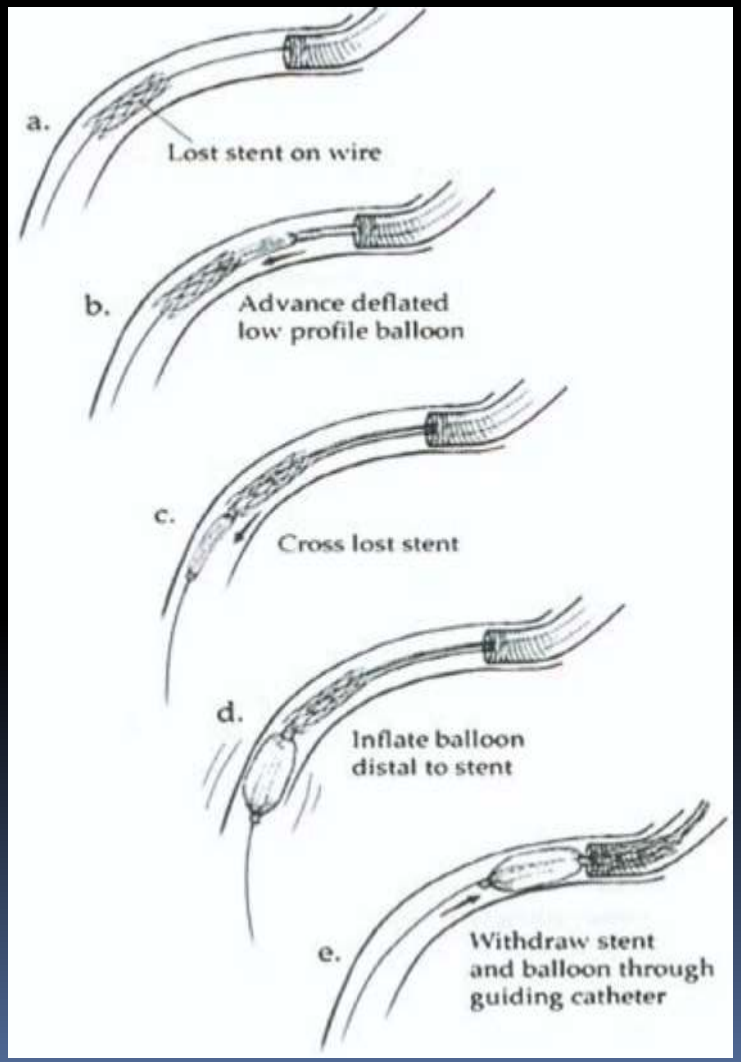
Stent Loss : Management

- Retrieval →
  - -From the coronary
    - Small-Balloon technique
    - Two-wire technique
    - Loop snare
  - -From the peripheral circulation
    - Loop snare, Basket, Forceps
- Intra coronary
  - -Deploy the stent
  - -Crush the stent
- Extra coronary
  - -Deploy or Crush the stent
  - -Leave undeployed

Retrieval Device/ Strategy	Total n = 368
Total	368
Snare	124 (33.7%)
Balloon	96 (26.1%)
Forceps	17 (4.6%)
Vascular surgery	15 (4.1%)
Basket	12 (3.2%)
Two-wire technique	4 (1.1%)
Cook retained fragment retriever	4 (1.1%)
Hairpin trap technique	2 (0.5%)
Whole system retraction	2 (0.5%)
Use of an embolic protection device	2 (0.5%)
Unknown	90 (24.5%)
Data given as number / total (percentage).	

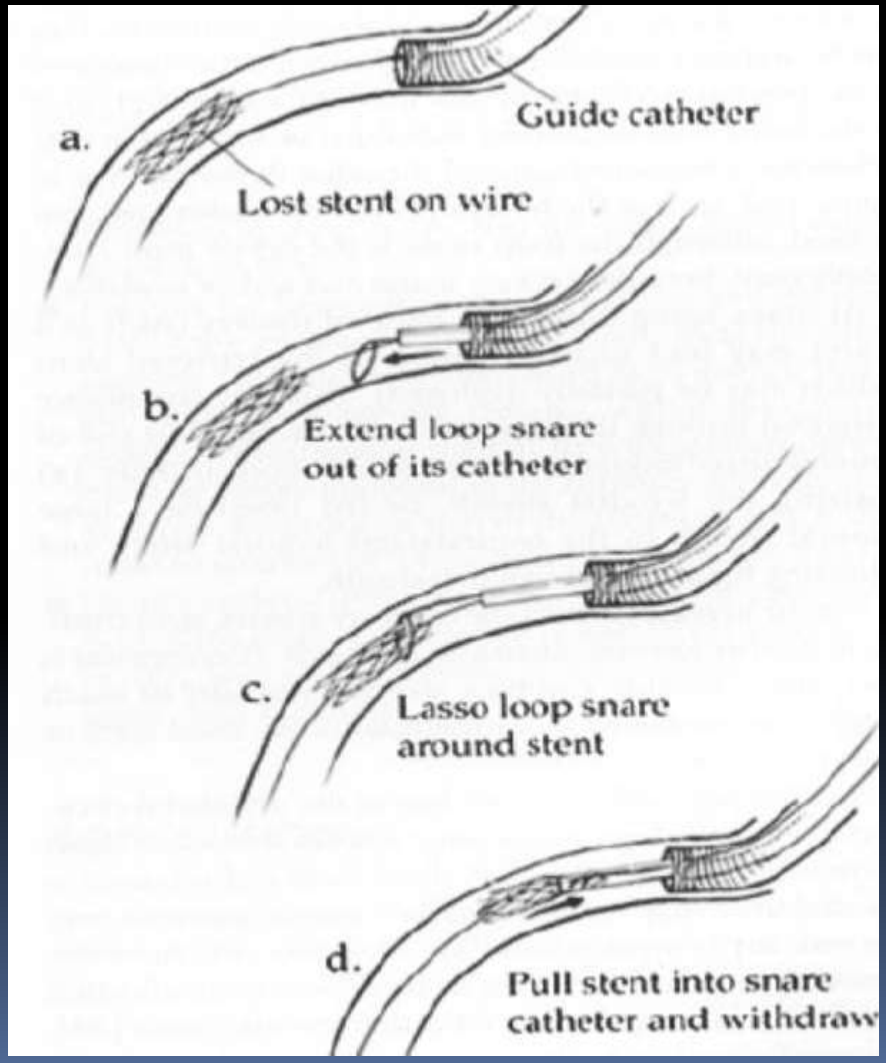
Retrieving the Stent : Small-Balloon Technique

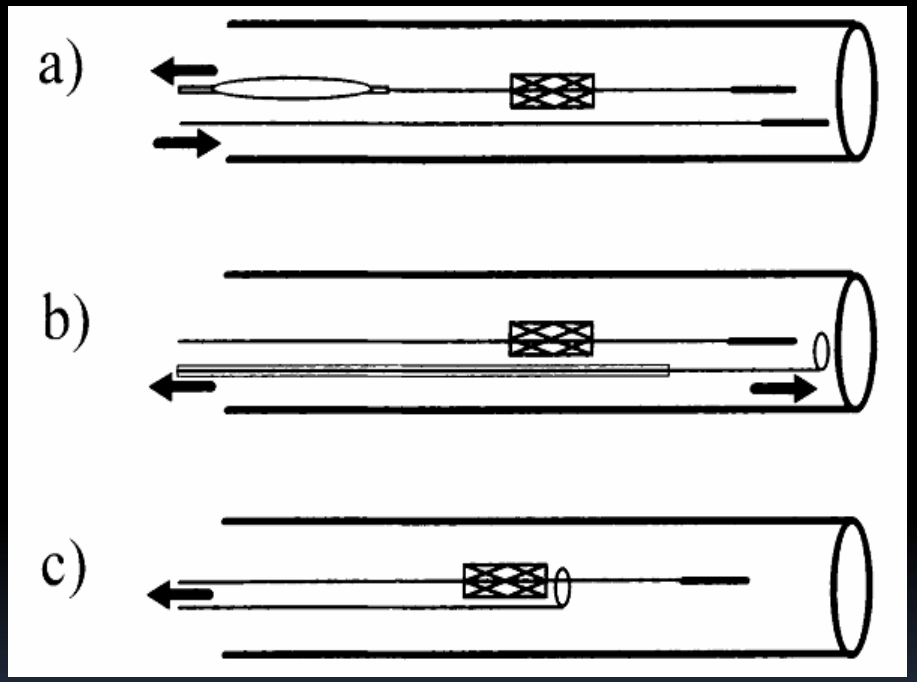
- Keep stent remains over the wire
- Advancing a small balloon (1.5mm)
- Inflate and withdraw(2~4 atm)
- The simplest and easiest way,
- Higher retrieval rate, ~70%



Small-Balloon Technique

Loop Snare



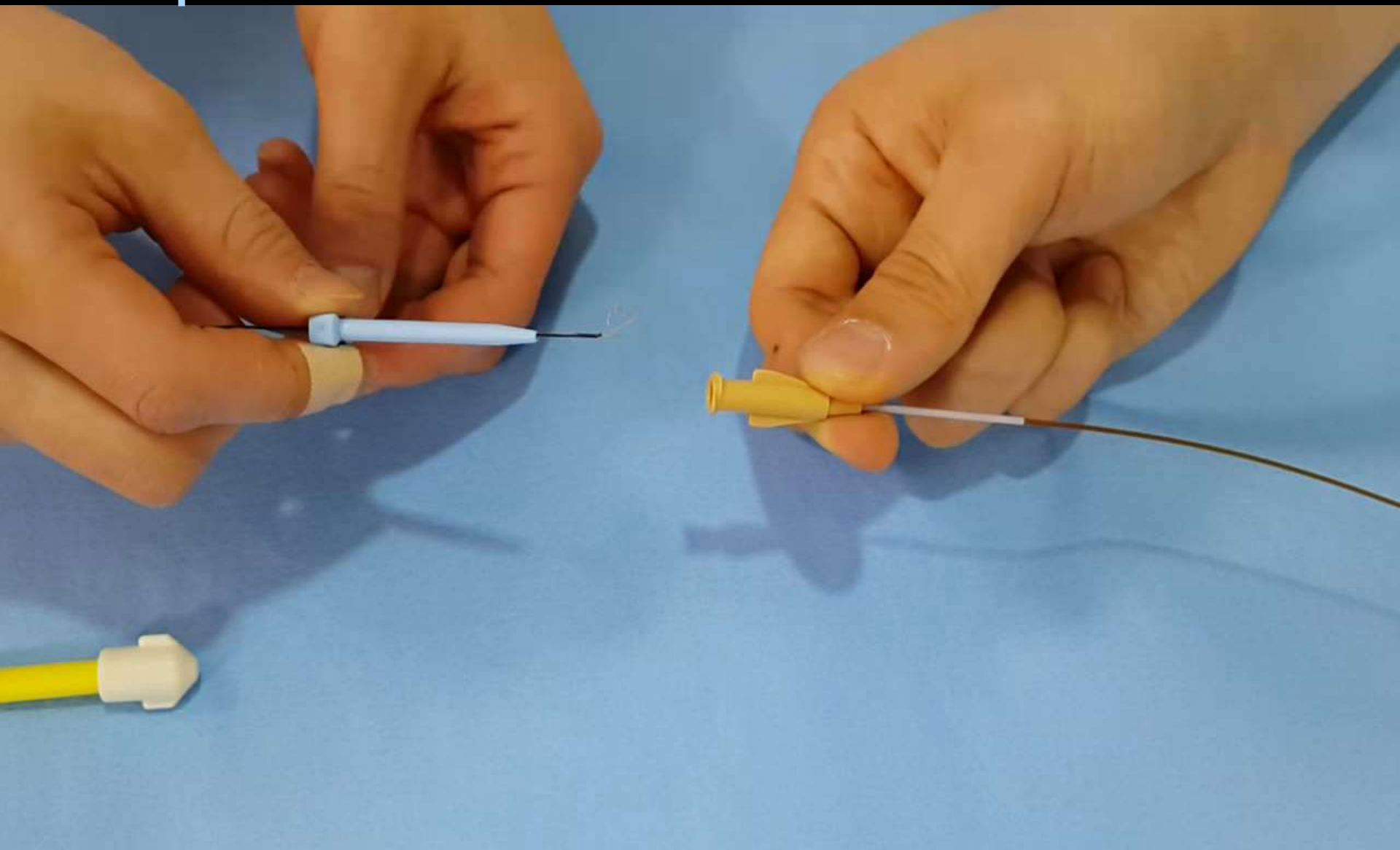


ElsnerM. Cathet Cardiovasc Diagn96;39:271

Loop Snare - direct

Loop Snare – Two wire

Loop Snare – Two wire



Loop Snare – Two wire

Wire fragment loss

- **Mechanisms of wire tip fracture**
  - → Much wire twisting
  - → Jailed wire by stent, especially in calcified lesions
  - → Ratablation
  - → Damaged and re-used wire

- **High risk**
  - → Some circumstances can cause entanglement and fracture
  - → Wire is positioned within a small branch (does not allow rotation)
  - → CTO lesions using retrograde access via the tiny collateral channels

Wire fragment loss (Complications->management)

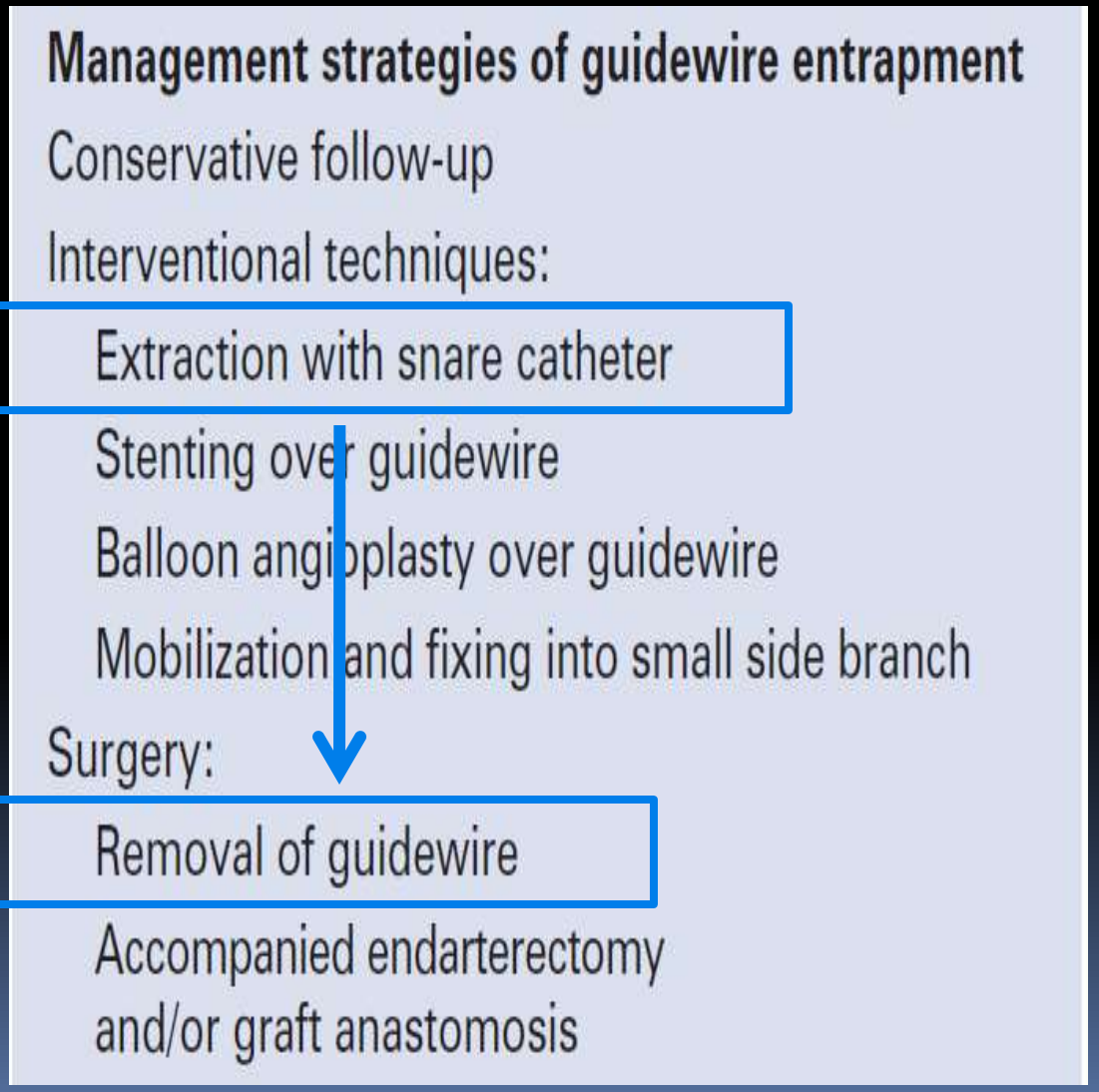
- **Complication**

→ Narrowing of the artery

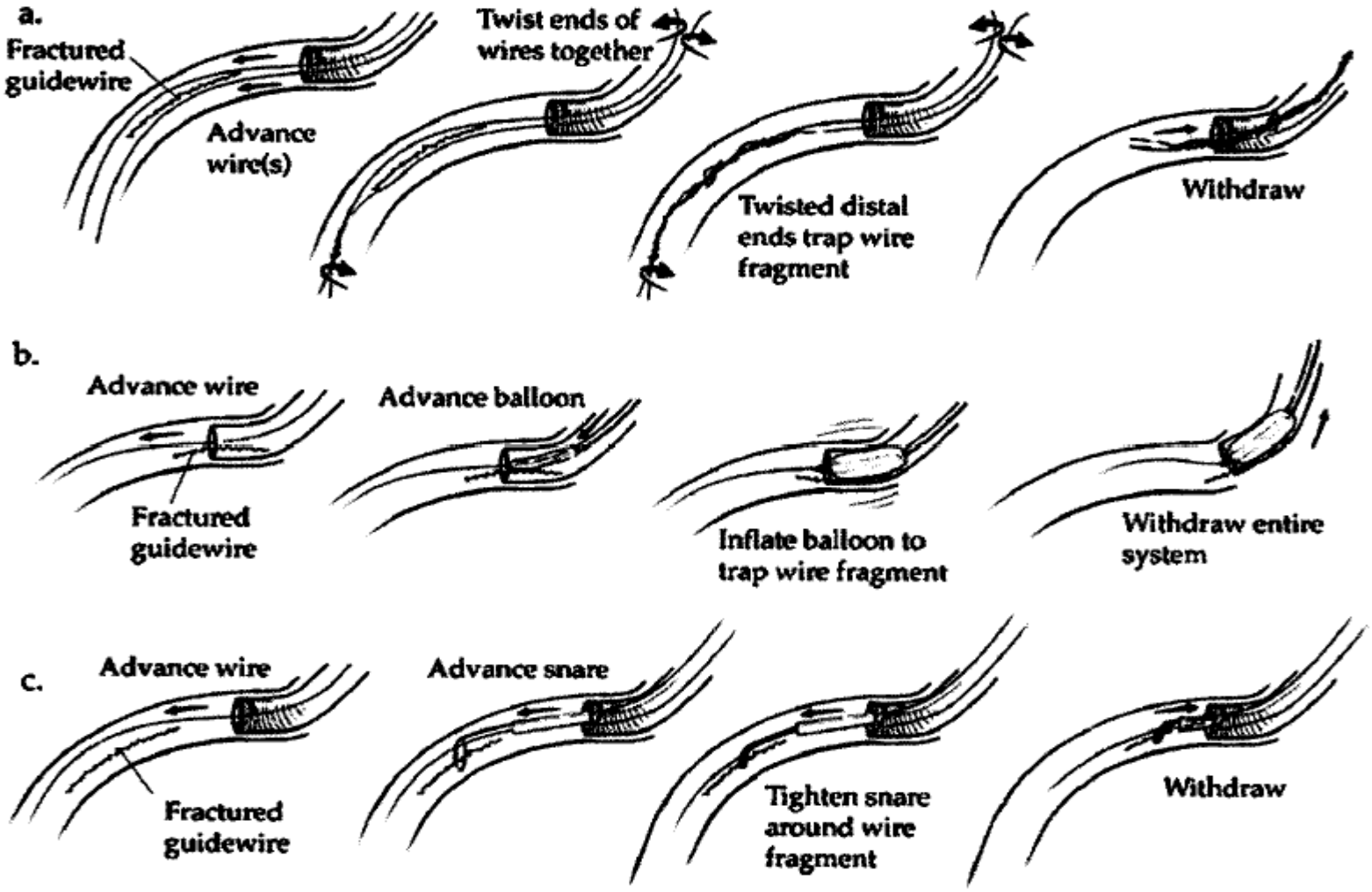
→ Late perforation

→ Arrhythmia

→ Thrombotic occlusion



The retrieval of guide wire fragments



Brilakis ES, et al. Strategic approaches in Coronary Intervention 42:434

Wire fragment loss (or entrapment) - Snare

Conclusion

How to avoid & management of CTO complication

↓ Successful CTO intervention

↓ Intervention complication overcome

→ The mortality of CTO PCI complications can be preventable event!!

→ Importance of experienced operator & assist backup & management!

→ Good understanding and management of complication increase the level of CTO-PCI

Thank you for your attention