

Ασθενής με ΣΤΕΡΗ που αντιμετωπίσθηκε με ΒΡΑ



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ΠΑΝΕΠΙΣΤΗΜΙΑΚΟ ΓΕΝΙΚΟ ΝΟΣΟΚΟΜΕΙΟ
«ΑΤΤΙΚΟΝ»



❑ **68 yrs old female**

Height: 170 cm - **BW:** 85 kgr (**BMI:** 29.41 kgr/m² , *Overweight*)

Arterial Hypertension since 10yrs

CAD (PCI LAD + RCA)

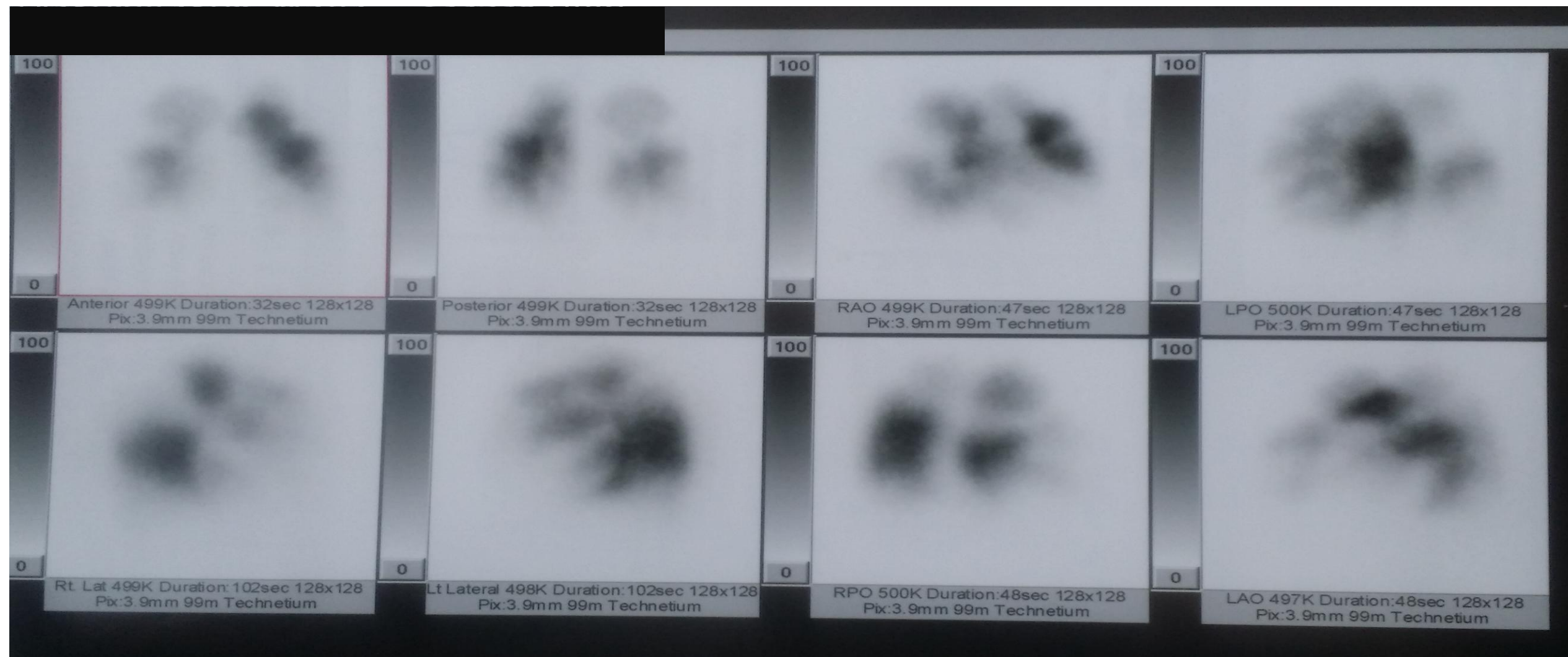
❑ ***February 2017 : Pulm. Embolism (1st episode)***

CT Scan Pulmonary Artery (12/2/2017)

- Multiple defects in subsegmental branches in the lower lobes (R+L) suggestive of acute PE
- Normal RV diameters

Started on Rivaroxaban

Lung Scintigraphy (16/2/17)



June 2017 : CTEPH diagnosis

CT Scan (12/6/2017)

Angiographic defects due to residual thrombi & Recanalized lesions in the lower lobes

(R+L)

Right Heart Cath (16 /6/2017)

- RV: 55/5mmHg
- RA: 5mmHg
- **PA: 55/20/30mmHg**
- **PCWP: 6mmHg**

6minute HWT

- 210 m in 5 minutes
- SpO2: 96% (before) > 89% (after)
- HR 67 bpm 108 bpm
- Borg scale: 4 (somehow severe dyspnea)

Echocardiogram 11/1/2018

- RA + LA dilation
- **RV dilatation normal systolic function (TAPSE =22mm)**
- Mild TR
- **RVSP = 53mmHg**
- Normal LV dimensions & systolic function (65%)

January 2018 Per. Os. Therapy for CTEPH

Started on ***Riociguat (Adempas) 0.5 mgr x3***

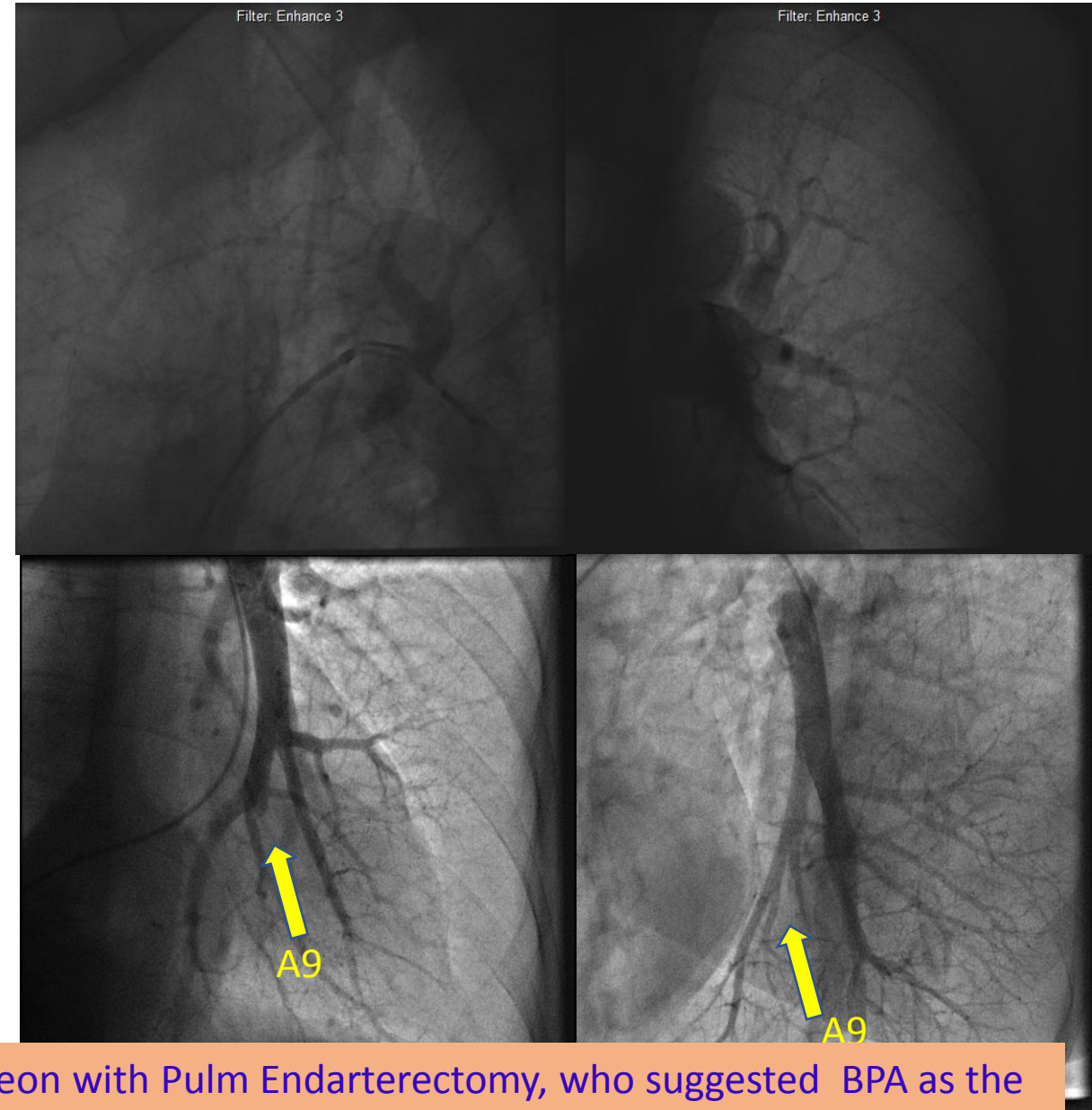
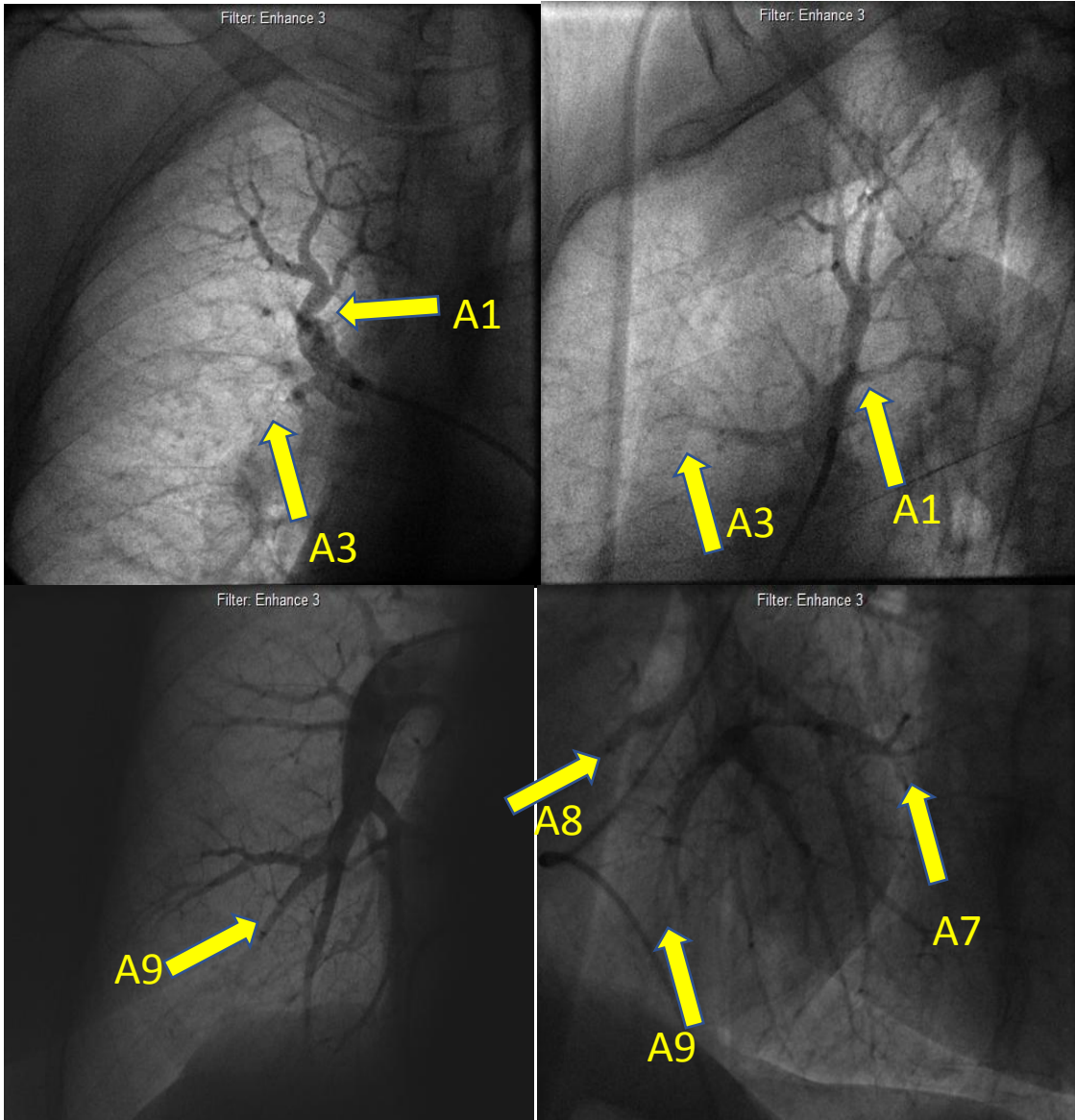
After 1-2 weeks developed hypotension and generalized fatigue and drug was discontinued

The patient started on ***Macitendan (Opsumint) 10mgr opd*** – (Endothelin Receptor Antagonist) - well tolerated by the patient

PEA or BPA

- ☐ The possibility of PEA discussed with surgeons and was turned down due to peripheral lesions
- ☐ Alternatively BPA suggested and patient consented

Pulmonary Angiography- Peripheral Lesions (Segmental Subsegmental)



Pulmonary angiogram reviewed by a highly experienced surgeon with Pulm Endarterectomy, who suggested BPA as the procedure of choice , due to peripheral location of the disease in segmental and subsegmental branches

FIRST BPA SESSION: Right Lung A8 Branch Angioplasty- Long B type Lesion

Maverick 3x20 mm Balloon
(8-10 Atm)
BMW wire 0.014 inch

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- ✓ RFV
- ✓ MPA1 , 6Fr catheter

Maverick 4x20 mm Balloon
(10 Atm)
BMW wire 0.014 inch

Right Lung, A8 Branch Long B type Lesion- Multiple Dilatations with 3mm & 4 mm diameter Balloons

PRE

POST

FIRST SESSION : Right Lung, A9 Branch Long A,B and C type Lesions - Multiple Dilatations with 2 mm diameter “undersized” Balloon

Maverick 2x20 mm Balloon (6-8 Atm)
BMW wire 0.014 inch

A9 branch subtotally occluded
(“type C”) distally with
Type A and B at a long segment
more proximally

Multiple dilatations with an
“undersized” 2 mm Balloon

Final angiographic result

FIRST SESSION: Right Lung, A4 Branch B type Lesions - Multiple Dilatations with 2 & 3 mm diameter Balloons

Maverick 2x20 mm Balloon (10 – 14 Atm)
BMW wire 0.014 inch

Maverick 3x20 mm Balloon (8-10 Atm)
BMW wire 0.014 inch

- ✓ After multiple dilatations with the 3 mm Balloon the pt developed “hemoptysis” with slight deterioration of SatO2 (94 > 92%)
- ✓ No contrast extravasation observed angiographically
- ✓ No hemodynamic or further respiratory deterioration
- ✓ No action was undertaken- Hemoptysis stopped
- ✓ Uneventful course thereafter

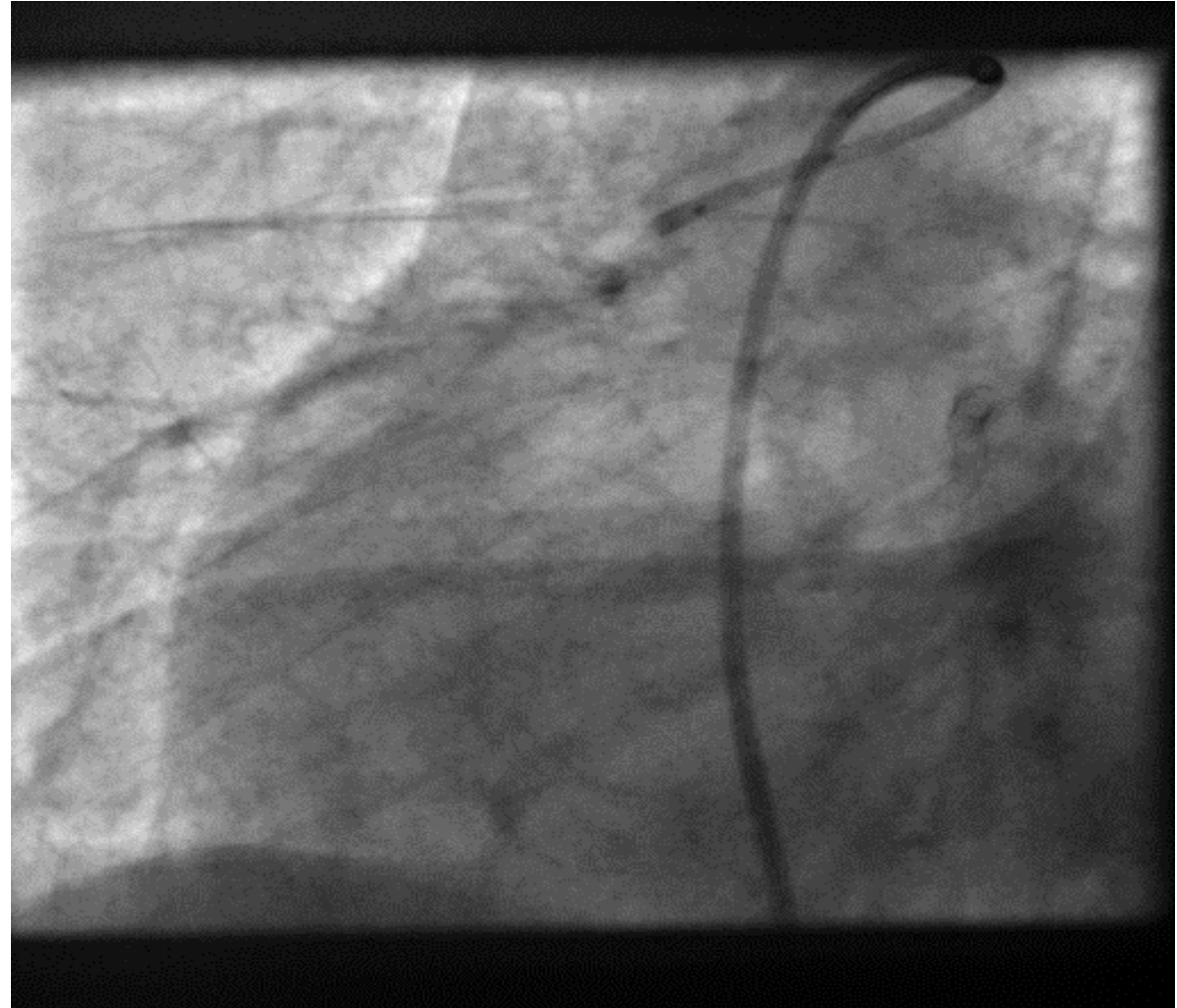
SECOND SESSION: Right Lung A5, (type C)



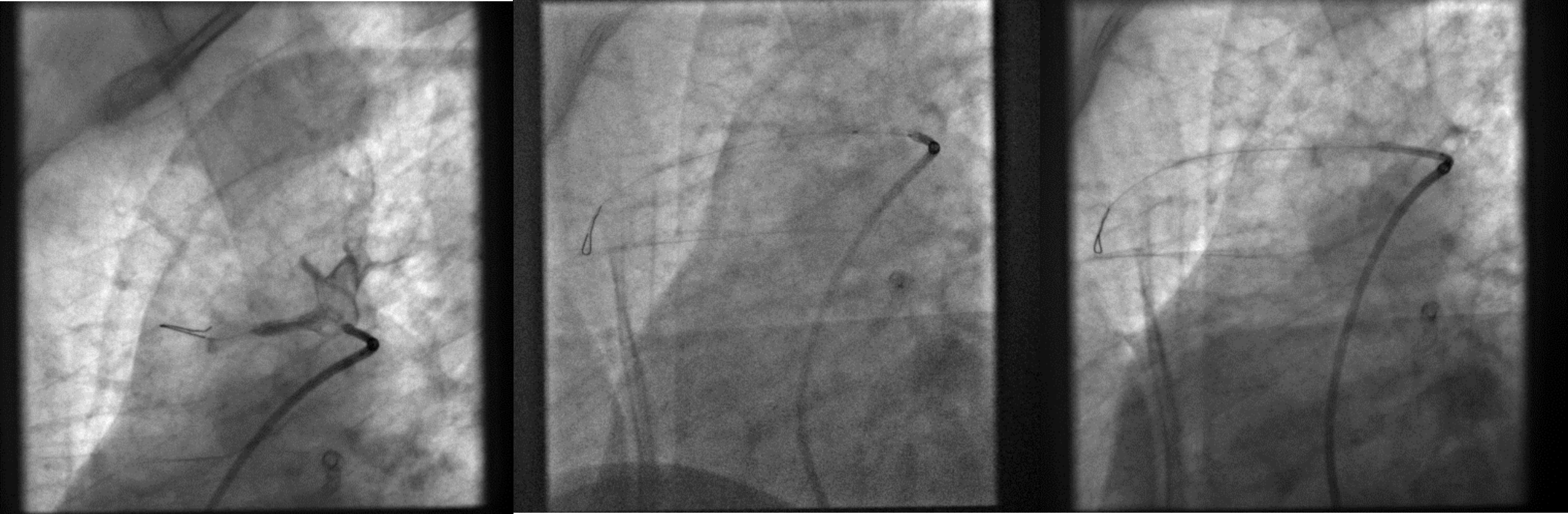
- ✓ AL1 6 Fr catheter
- ✓ Whisper LS
- ✓ Maverick 2x15 & 3x20 mm (8-10 Atm)

SECOND SESSION: Right Lung A5, (type C)

- ✓ After multiple dilatations with the 3 mm Balloon the pt developed “hemoptysis” with slight deterioration of SatO₂ (94 > 92%) and tachycardia (75 > 92 bpm)
- ✓ No contrast extravasation observed angiographically
- ✓ Multiple balloon inflations at the site of subtotal occlusion (15 min total inflation time)
- ✓ Gradual elimination of hemoptysis
- ✓ 24hrs later CT scan and CXR no pulmonary infiltrates
- ✓ Remained at the CCU for 24 hrs non invasive ventilatory support (Venturi mask)

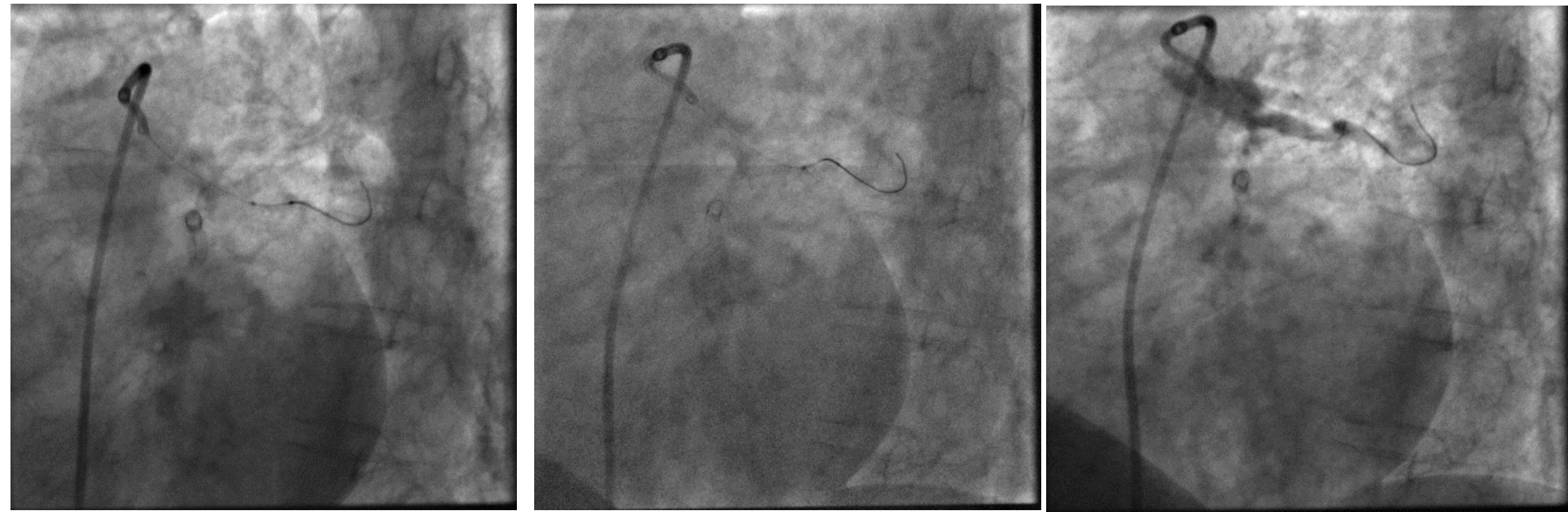


THIRD SESSION : Right Lung A3 (type B)



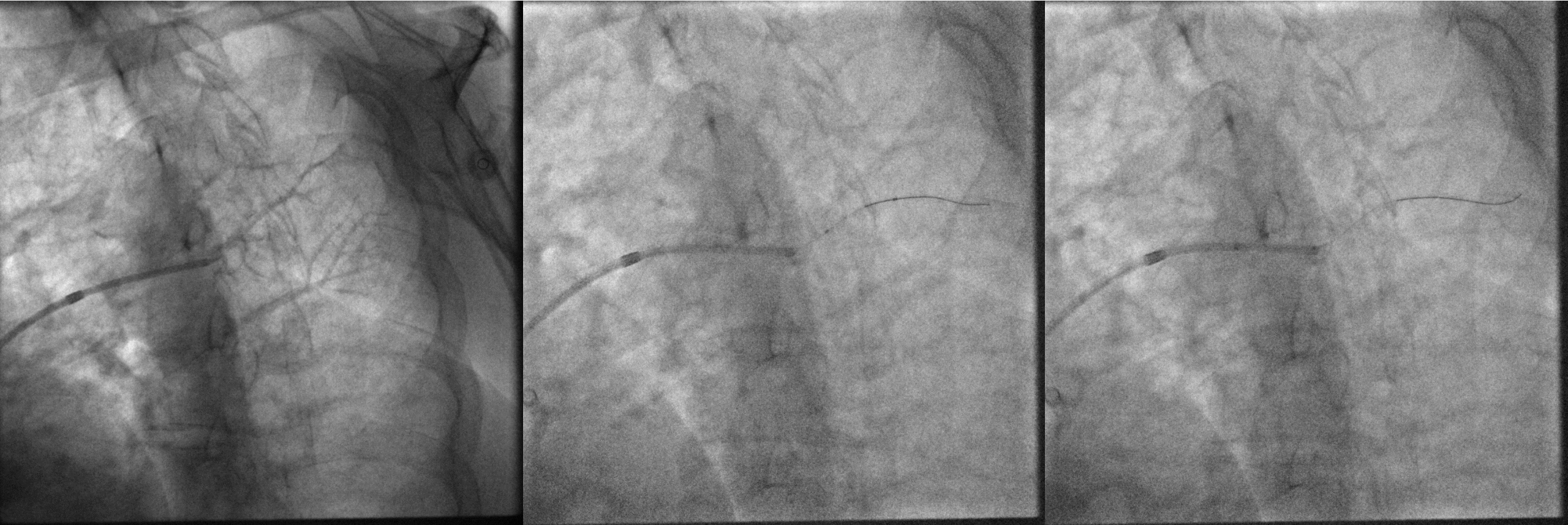
- ✓ *MP 6 Fr catheter*
- ✓ *Sion Blue*
- ✓ *Maverick 3x15 & 3,5x20 mm Maverick 5x15 mm (8-10 Atm)*

THIRD SESSION : Right Lung A6 (type C/D)



- ✓ AR 2, 6 Fr catheter
- ✓ SiMaverick 2x20 mm (8-10 Atm)
- ✓ on Blue

FOURTH SESSION : Left A2 (type A/B)

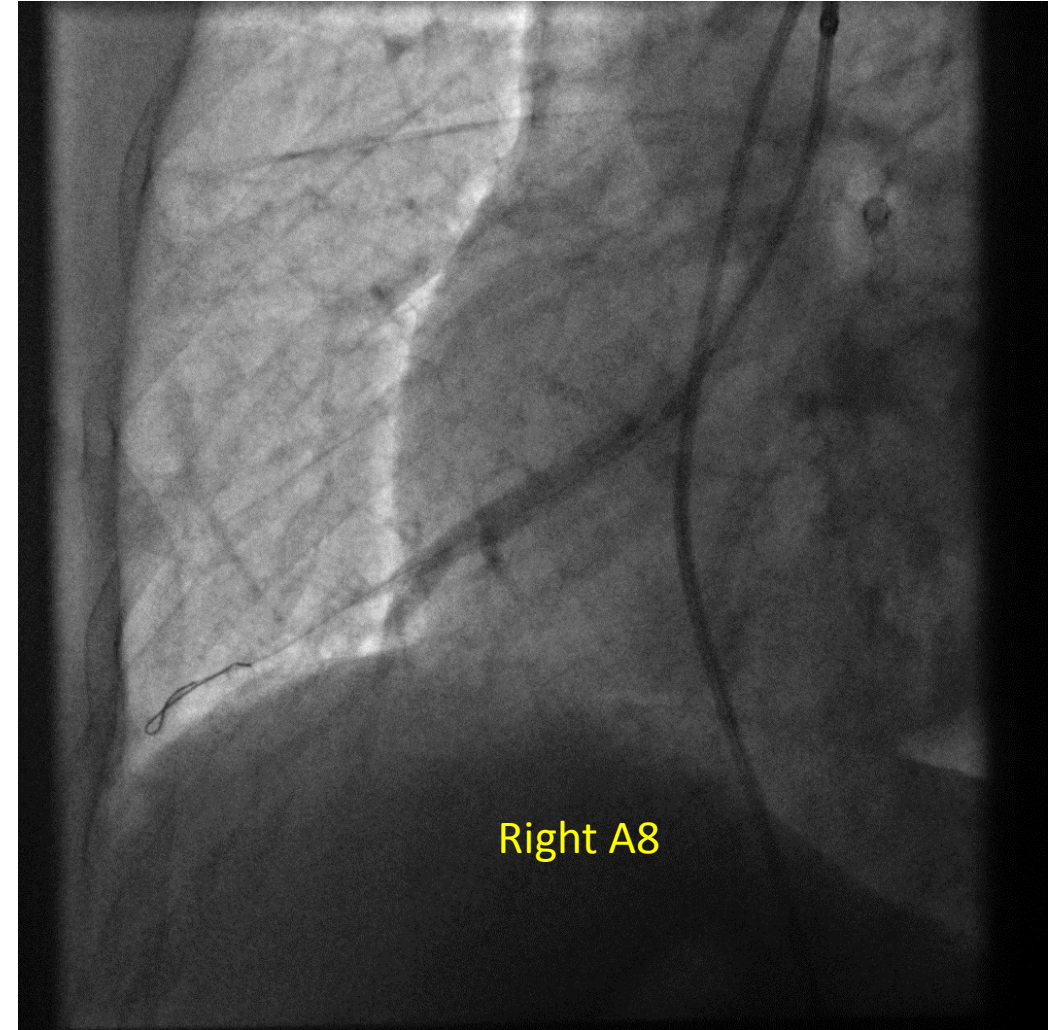
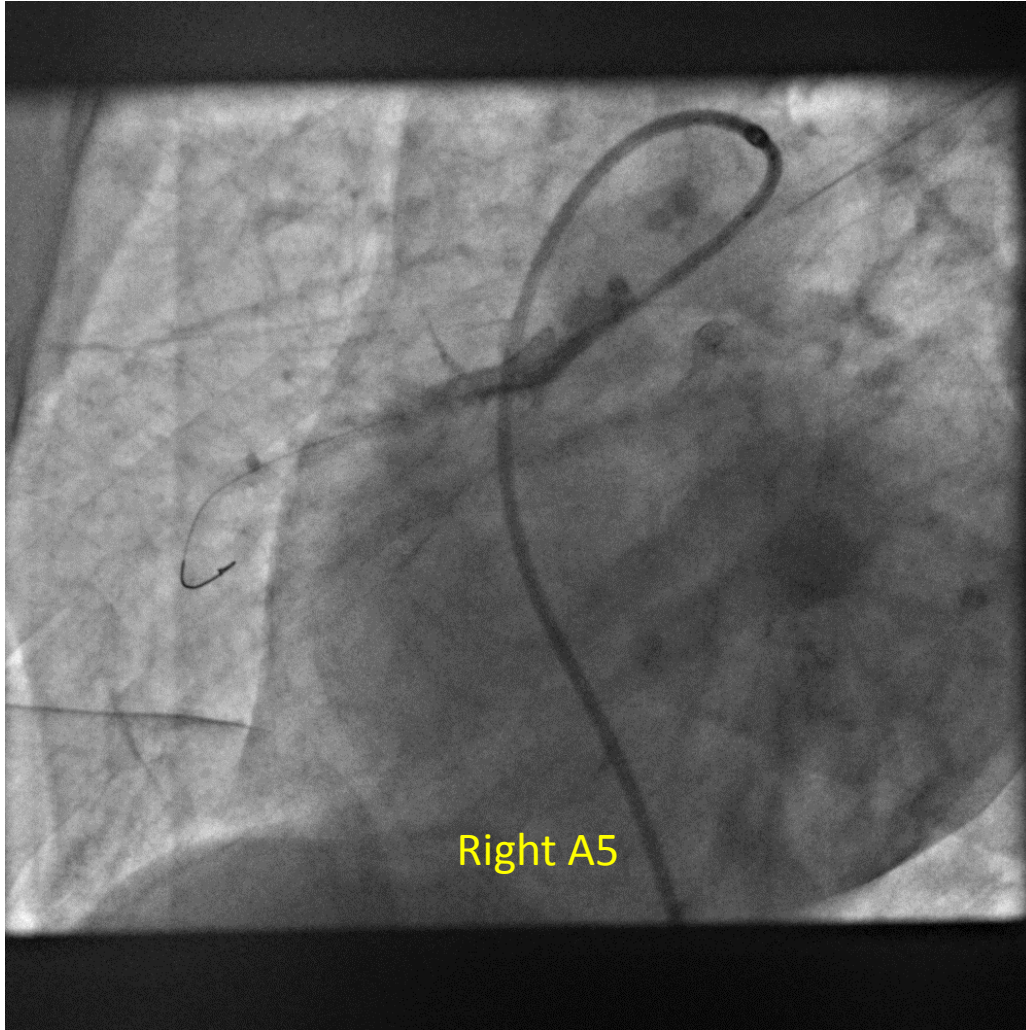


- ✓ *MP , 6 Fr catheter*
- ✓ *Sion Blue*
- ✓ *Maverick 2x20 mm (8-10 Atm)*

FOURTH SESSION : Left A8 (type A/B)



FOURTH SESSION : Right A5 & A8



Evolution of Hemodynamics in 1 year period

	PCWP	PA (mmHg)	RV (mmHg)	RA (mmHg)	CO (Lt /min)	CI (L/min/m2)	PVR (WU)
<i>1st Session</i>	<i>11</i>	<i>51/21/32</i>	<i>51/5</i>	<i>5</i>	<i>4.6</i>	<i>2.3</i>	<i>5</i>
<i>2nd Session</i>	<i>12</i>	<i>46/17/30</i>	<i>49/9</i>	<i>6</i>	<i>5.06</i>	<i>2.73</i>	<i>3</i>
<i>3rd Session</i>	<i>11</i>	<i>45/13/26</i>	<i>45/6</i>	<i>5</i>	<i>5.31</i>	<i>2.61</i>	<i>2</i>
<i>4th Session</i>	<i>11</i>	<i>43/ /24</i>	<i>44/6</i>	<i>4</i>	<i>5.4</i>	<i>2,82</i>	<i>2</i>

- ✓ 10 months after the first BPA session pt had a significant improvement in her exercise capacity (NYHA II)
- ✓ Dyspnea: Borg scale 2 (weak)
- ✓ No angina

Therapy

- Rivaroxaban 15 mgr 1x1
- Clopidogrel 75 mgr 1x1
- Macitentan 10mgr 1x1
- Furosemide 40mgr + Amiloride 5mgr 1x1
- Valsartan 150 mgr 1x1
- Nebivolol 5mgr ½ x1
- Lipitor 40mgr 1x1

Why Balloon Pulmonary Angioplasty?

- ❑ CTEPH has an estimated
 - ✓ 5-year survival of 30% in patients with mean pulmonary artery pressure (mPAP) >40 mmHg and
 - ✓ 5-year survival of 10% with mPAP >50 mmHg
- ❑ Gold standard therapy remains **pulmonary endarterectomy (PEA)**, BUT
 - **<60% of patients with CTEPH can undergo PEA** (Non operable : distal lesion+ medical comorbidities)
 - **PH persists or recurs after PEA in 17–31% of patients** (J Thorac Cardiovasc Surg 2011; 141: 702–710)
- ❑ Previous studies using PH **specific drugs** failed to decrease the patient's mean PAP below 30 mmHg

Riociguat is currently the only medical therapy licensed for the treatment of CTEPH as it has been shown to improve haemodynamics and exercise capacity (class I recommendation, level of evidence B)

❑ ***Interventional treatment for CTEPH*** first reported in 1988

❑ ***In 2001, Feinstein et al.*** reported efficacy of BPA in 18 inoperable patients with CTEPH (*Circulation. 2001; 103: 10-13*)

- **Decreased mean PAP** from 43 ± 12.1 to 33.7 ± 10.2 mmHg
- One patient died (**in hospital mortality 5.5%**)

❑ Lately (after 2012) several ***Japanese centres*** with long term follow-up (>1yr) described improvement

- ✓ ***Haemodynamics***
- ✓ ***Symptoms***
- ✓ ***Exercise capacity***
- ✓ ***Low rates of major complications*** and ***post-procedural mortality***

2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension

Recommendations	Class ^a	Level ^b
Interventional BPA may be considered in patients who are technically non-operable or carry an unfavourable risk:benefit ratio for PEA	IIb	C

BPA is a complex procedure that is not risk free

BPA potentially be used in :

- ☐ Inoperable CTEPH due to ***distal distribution of vascular obstructions***
- ☐ high surgical risk due to ***comorbidities***
- ☐ Patients with ***persistent/recurrent PH after PEA*** and an inadequate response to medical therapy.

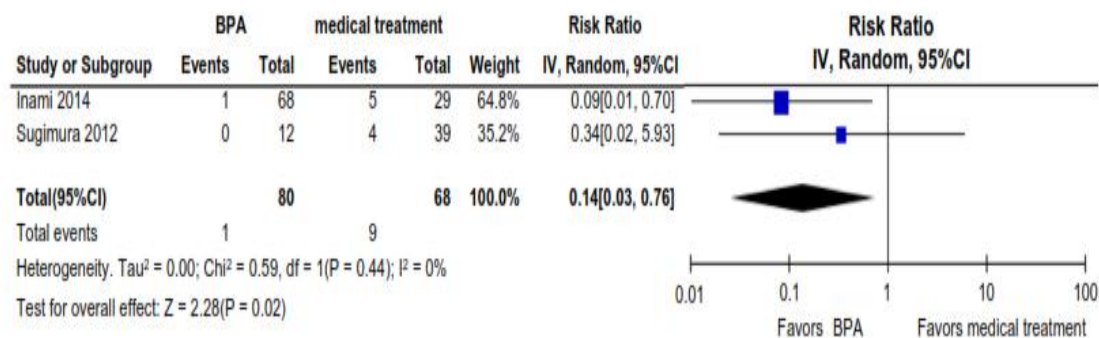
Comparison of efficacy between BPA and medical treatment or PEA.

First author Date, [Study#]	No. of pts.	mPAP Pre (mm Hg)	mPAP post (mm Hg)	PVR pre (WU)	PVR post (WU)	6-MWD pre (m)	6-MWD post (m)	WHO FC pre (mean value)	WHO FC post (mean value)
Sugimura, 2012 [#2]	BPA 12	43.2±9.5	24.8±4.9 [*]	8.4±3.0	3.9±0.9 [*]	340±112	441±76 [*]	2.6	2.0 [*]
	Control (the same pts. before BPA) 12	47.8±11.6	43.2±9.5	12.1±6.3	8.4±3.0 [*]	350±105	340±112	2.9	2.6
	Control (medical) Historical 39	43.4±11.5	NR	10.6±4.9	NR	288±157	NR	2.5	NR
Inami, 2014 [#5]	BPA 68	41.9±11.8	25.0±6.1 [*]	11.4±5.3 (TPR)	6.2±2.6 [*] (TPR)	349 ± 130	424±111 [*]	2.9	Figure only [*]
	Control (medical) 29	38.4±9.7	33.8±11.9	12.7±8.1 (TPR)	9.3±7.7 (TPR)	NR	NR	2.5	NR
	Control PEA 39	53.1 [*]	27.9 [*]	17.5	7.5 [*]	326±116	353±93	3.2	Figure only [*]
Taniguchi, 2014 [#4]	BPA	39.4±6.9 [*]	21.3±5.6 [*]	9.5±3.9 [*]	3.6±1.6 [*]	295±95 [*]	397±117 [*]	3.2	1.7 [*]
	Control PEA	44.4±11.0 [*]	21.6±6.7 [*]	9.8±3.5 [*]	3.2±1.6 [*]	NR	NR	3.2	1.5 [*]
Aoki, 2017 Ref. [21]	BPA 77	38±10	25±6 [*]	7.3±3.2	3.8±1.0 [*]	380±138	486±112 [*]	2.4	?
	Control (the same pts. before BPA) 77	41±19	38±10 [*]	10±4.6	7.3±3.2 [*]	320±136	380±138 [*]	?	2.4
	Control (medical) Historical 20	41±8	NR	10±4.5	NR	280±166	NR	2.9	NR

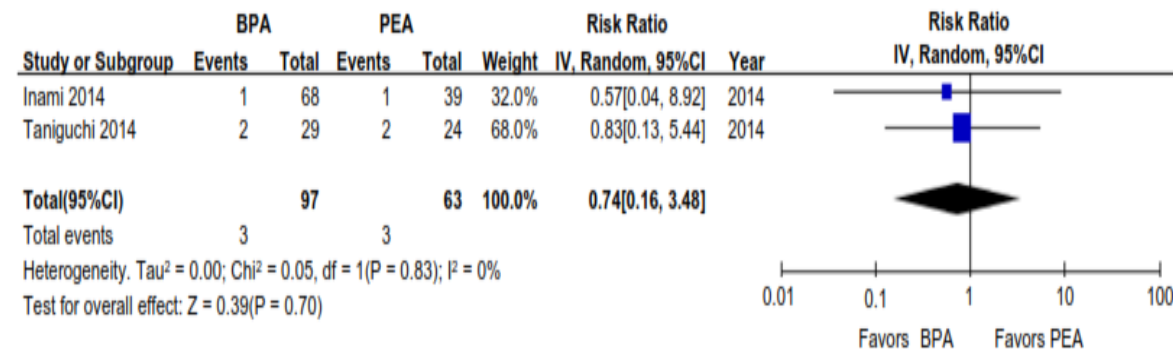
Mean±SD. [#] from Table 2 no. NR: not reported, PEA: pulmonary endarterectomy, mPAP: mean pulmonary arterial pressure, PVR: pulmonary vascular resistance, TPR: total pulmonary vascular resistance, 6-MWD: 6-min walk distance, WHO FC: World Health Organization functional class.

^{*} p<0.05.

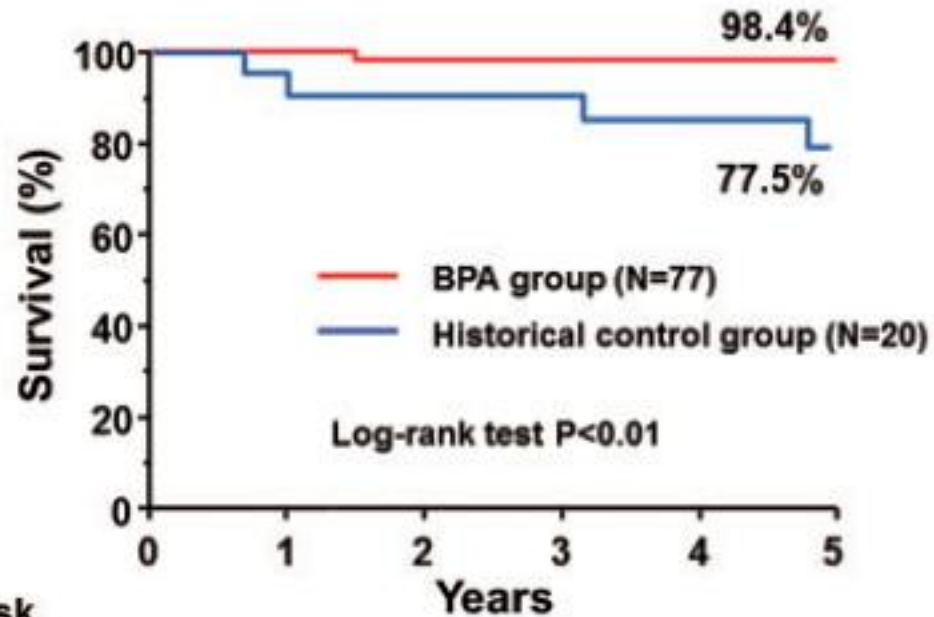
Comparison of two-year mortality between the BPA and medical treatment groups
1.3% vs. 13.2%, respectively; risk ratio (RR), 0.14 [95% CI 0.03–0.76], p=0.028



Comparison of two-year mortality between the BPA and PEA groups.
2.1% vs. 4.8%, respectively; RR, 0.74 [95% CI 0.16–3.48], p=0.7



Effectiveness and safety of BPA for inoperable CTEPH : long-term effects and procedure-related complications

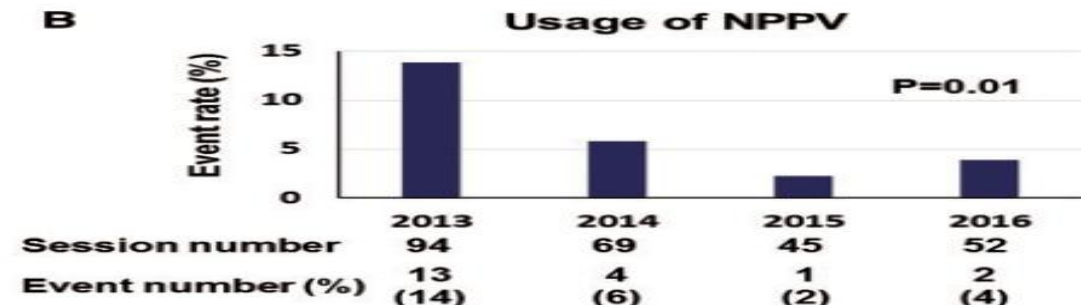
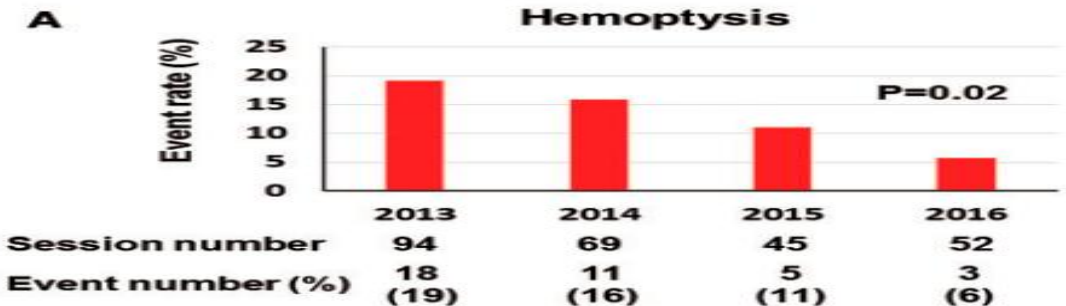


Number at risk							
		0	1	2	3	4	5
BPA	77	70	58	41	30	19	
Historical control	20	19	17	16	14	12	

Complications (%)

N = 424^a

Pulmonary arterial dissection	30 (7)
Haemoptysis	60 (14)
Pulmonary oedema	4 (1)
Use of NPPV	33 (8)
Oral intubation	1 (<1)
Peri-procedural death	0 (0)



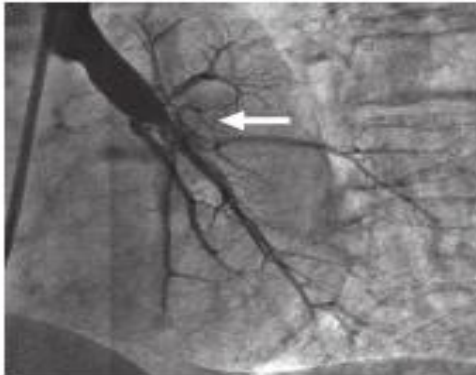
Classification of Angiographic lesions in CTEPH

Angiograms Showing Favorable Versus Unfavorable Anatomy for Angioplasty

Ring-like stenosis
(Bands) A



Web lesions B



Subtotal lesions C



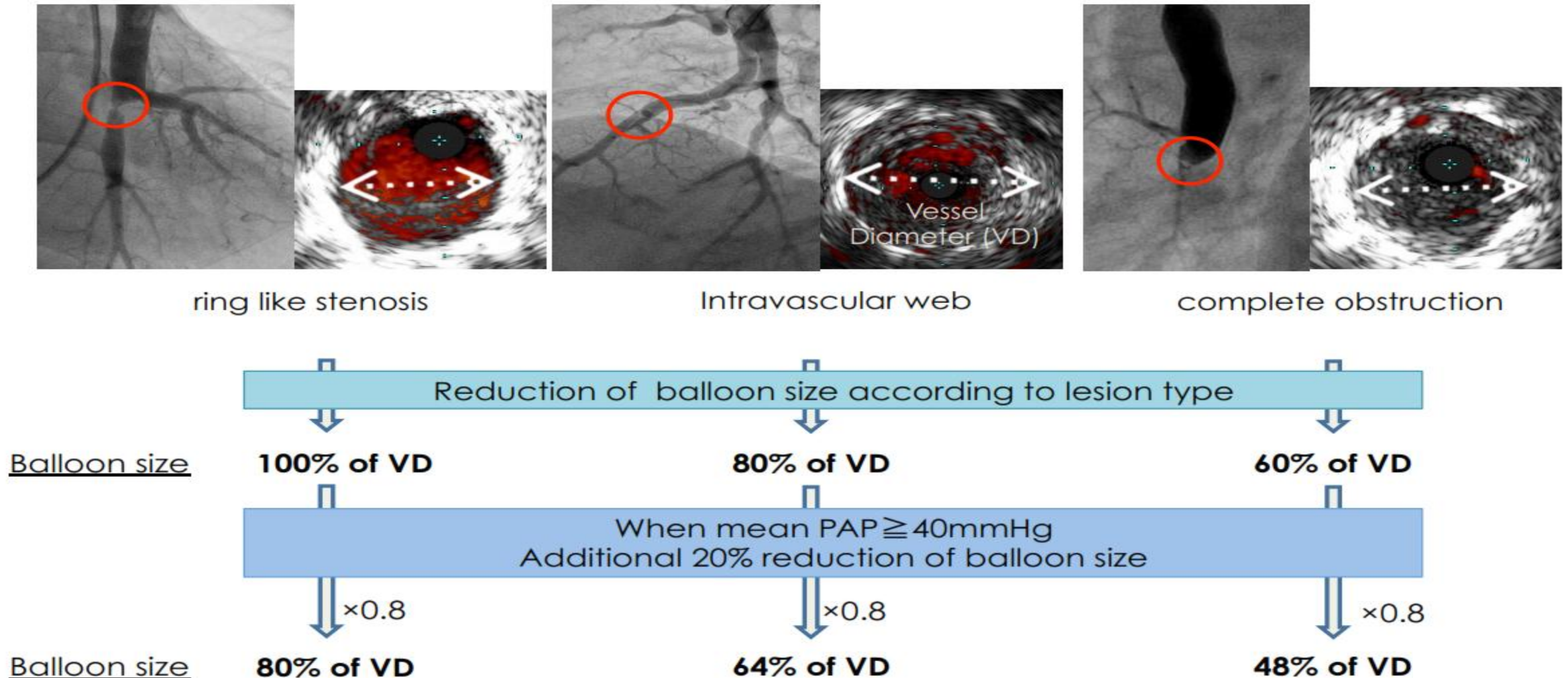
Total occlusion lesions
(Pouch defect) D



Tortuous lesions E



Adequate Balloon Sizing Depending on “Accurate Vessel Diameter on IVUS”, “Angiographic Lesion Type” and “Mean PAP”



Evolution of BPA Strategy

Initial Strategy
2004~2012.Oct



Balloon size

As large as possible

Treated vessels

2 vessels

Pulmonary injury



Hemodynamic improvement in a procedure



Previous Strategy
2012.Nov~2013.Nov



**Under sized
corresponding to lesion
type and mPAP**

2 vessels



Current Strategy
2013.Dec~



**Under sized
corresponding to lesion
type and mPAP**

As many as possible



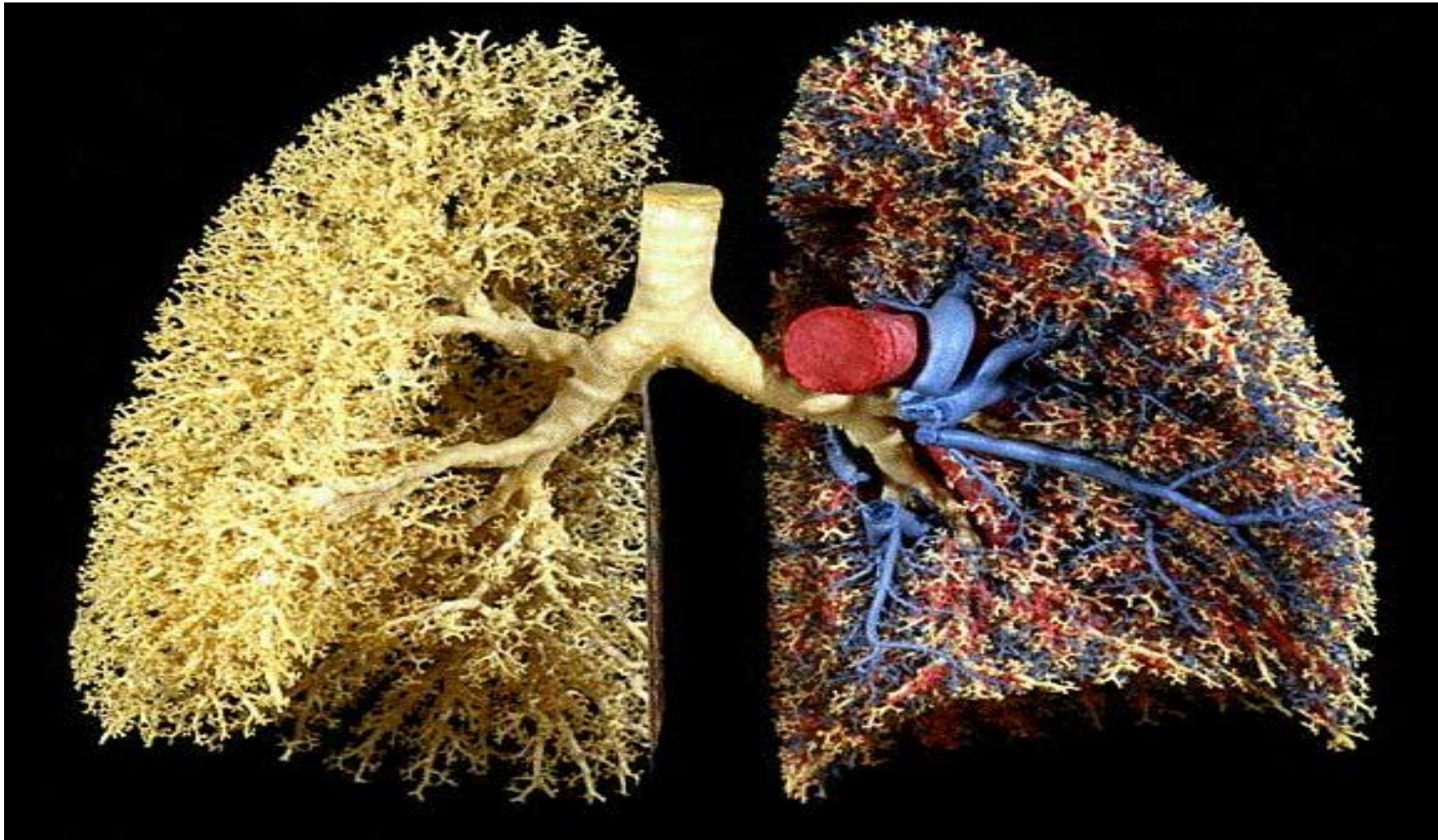
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Conclusions

- ❑ **Excellent outcomes** is obtained with BPA in patients **unsuitable for PEA**
- ❑ BPA currently is still considered as an **alternative to medical treatment in inoperable CTEPH patients**
- ❑ **Safety and efficacy of BPA** is greatly depended on the **experience of the operator and the technique used**

What we need more....

- ❑ Improved strategies to **overcome the complications** associated with BPA
- ❑ **BPA-specific devices**, such as guiding catheters, guidewires, and balloon catheters
- ❑ **Randomized control trials** to prove the superiority of BPA over drug therapy
- ❑ Long-term data on **restenosis & the need for stenting and survival**.....



Ευχαριστώ.....

The treatment of choice for CTEPH is :

- a. Pulmonary Endarterectomy (PE)
- b. Balloon Pulmonary Angioplasty (BPA)
- c. Medical Therapy
- d. None of the above

Surgical PEA in deep hypothermia
circulatory arrest is recommended for
patients with CTEPH

I

C

Medical treatment of CTEPH with targeted therapy may be justified in technically **non-operable patients** or in the presence of an **unacceptable surgical risk/benefit ratio**. Which of the following drugs is better documented for those patients :

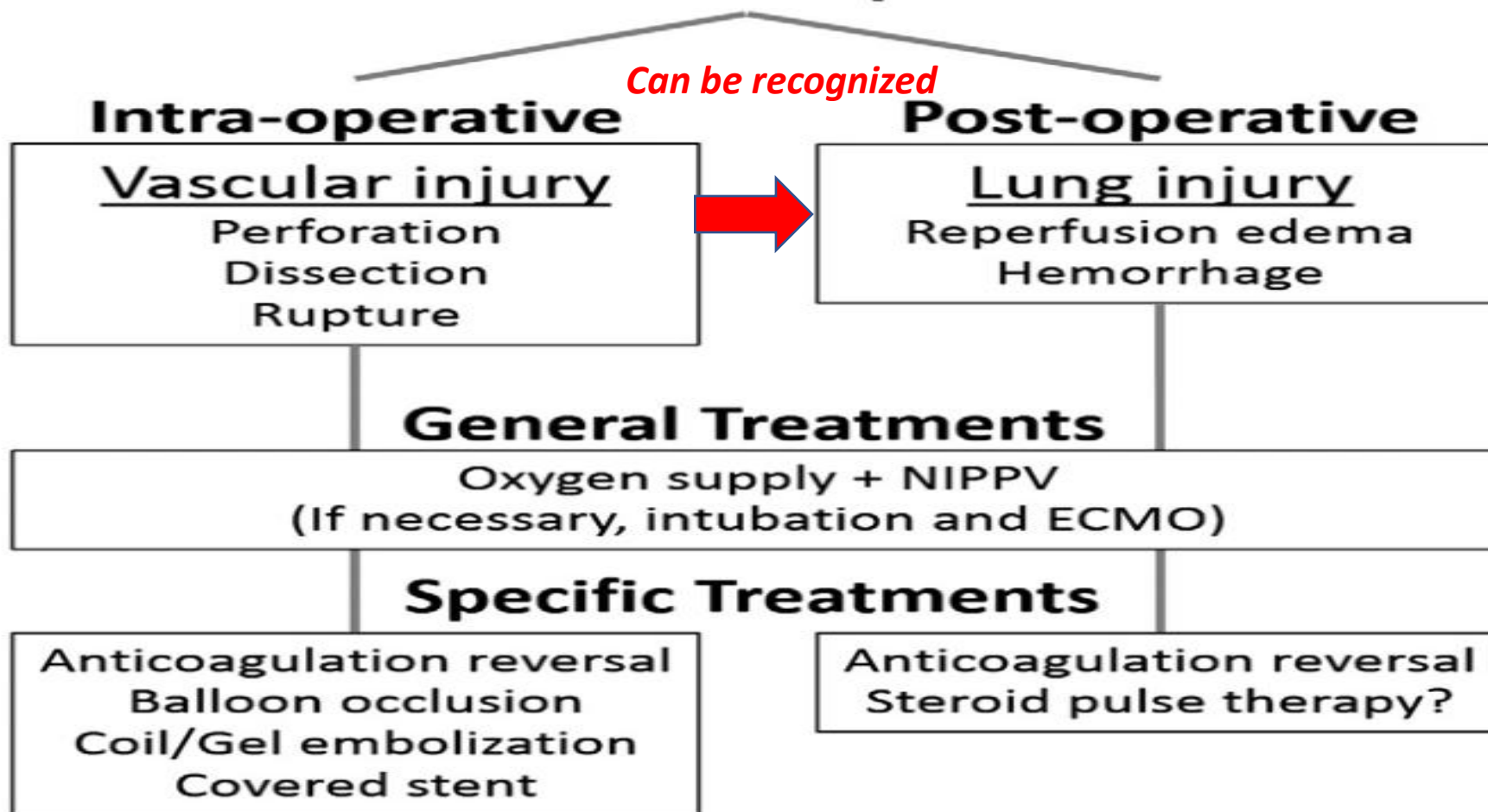
- a. Bosentan
- b. Macitendan
- c. Riociguat
- d. All of the above

Riociguat is recommended in symptomatic patients who have been classified as having persistent/recurrent CTEPH after surgical treatment or inoperable CTEPH by a CTEPH team including at least one experienced PEA surgeon	I	B	441
Off-label use of drugs approved for PAH may be considered in symptomatic patients who have been classified as having inoperable CTEPH by a CTEPH team including at least one experienced PEA surgeon	IIb	B	437– 440

Balloon Pulmonary Angioplasty should be considered as an alternative treatment for PEA , in patients with CTEPH in the following cases :

- a. Peripheral Lesions (segmental/subsegmental branches) of the Pulmonary artery
- b. Central Lesions (proximal Pulmonary artery branches)
- c. Patients with persistent/recurrent PH after PEA (+ inadequate response to therapy)
- d. All of the above
- e. b
- f. a+c

BPA related complications

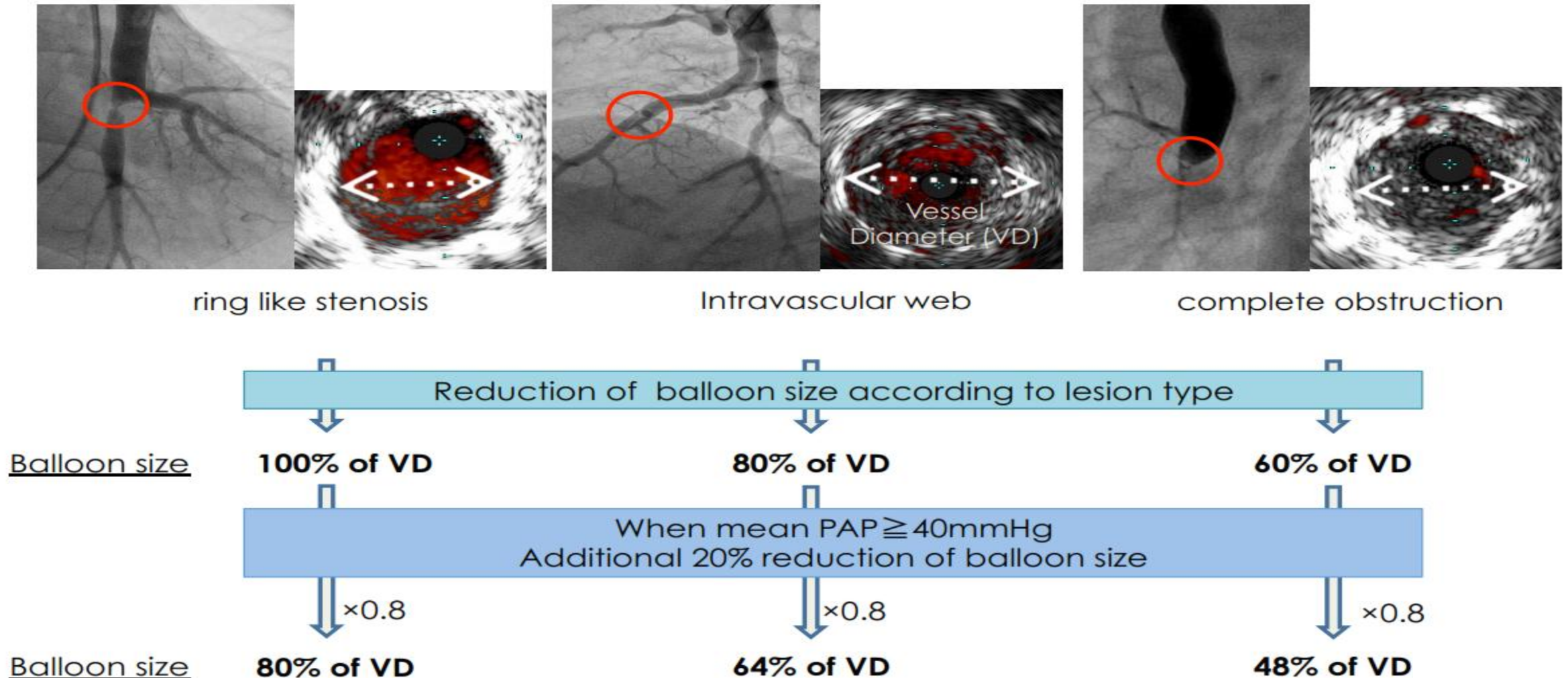


Alarming signs during the procedure

- Hemosputum
- Desaturation
- Increase in mPAP
- Tachycardia

“PAI and RPI are iatrogenic complications that may have serious outcome in patients with known severe hemodynamic status (Mean PAP >35 or 40 mmHg) “

Adequate Balloon Sizing Depending on “Accurate Vessel Diameter on IVUS”, “Angiographic Lesion Type” and “Mean PAP”



Evolution of BPA Strategy

Initial Strategy
2004~2012.Oct



Previous Strategy
2012.Nov~2013.Nov



Current Strategy
2013.Dec~



Balloon size

As large as possible

**Under sized
corresponding to lesion
type and mPAP**

**Under sized
corresponding to lesion
type and mPAP**

Treated vessels

2 vessels

2 vessels

As many as possible

Pulmonary injury



?

**Hemodynamic
improvement in a
procedure**



