

University of Pavia - School of Medicine
Foundation I.R.C.C.S. Policlinico "San Matteo"
Cardiac Surgery 2 - Chronic Thromboembolic Pulmonary Hypertension Centre
Pavia, Italy



Prof. Andrea M. D'Armini, M.D.

**APPROCCIO MULTIMODALE
NEL TRATTAMENTO DEL PAZIENTE AFFETTO DA
IPERTENSIONE POLMONARE CRONICA TROMBOEMBOLICA**



FINANCIAL DISCLOSURE

Last three years

AOP Orphan
Janssen Pharmaceutical
MSD

GENERAL CONSIDERATIONS

CTEPH is a two-cause disease

- Mechanical obstruction → PEA and BPA are the therapeutic options
- Microvascular disease Eisenmenger's like → specific medical therapy

GENERAL CONSIDERATIONS

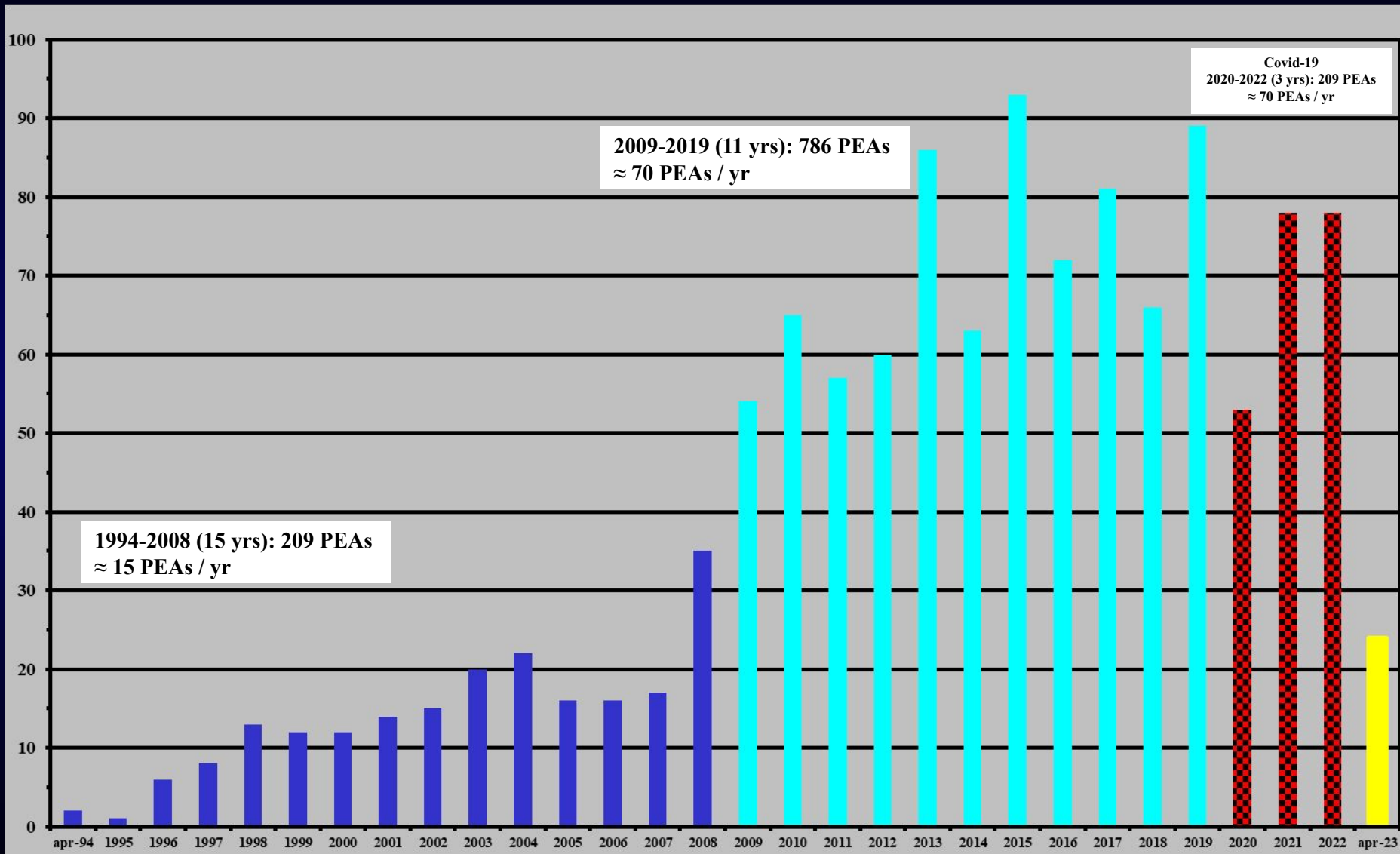
Regarding the treatment of mechanical obstruction in CTEPH the border between PEA and BPA is Center specific and depends mainly on the team experience

OPERABILITY ASSESSMENT

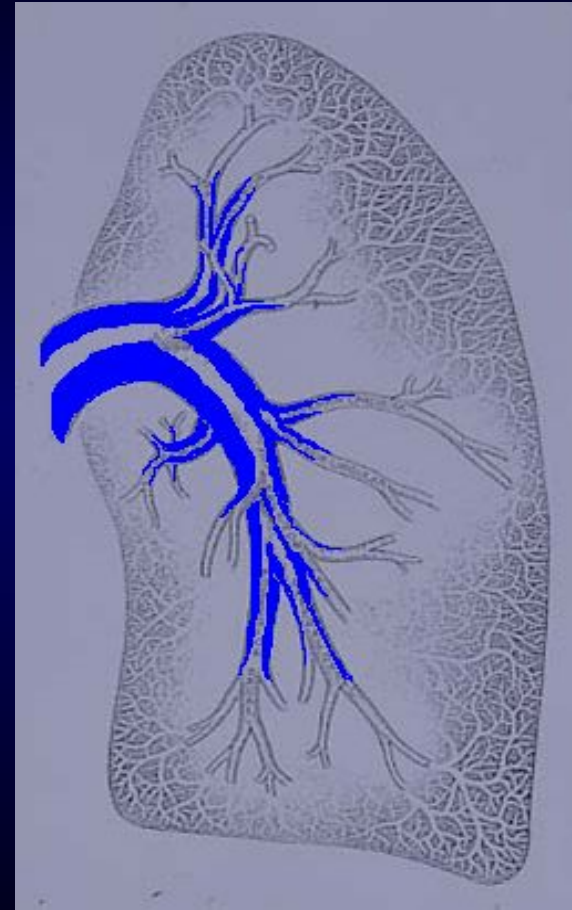
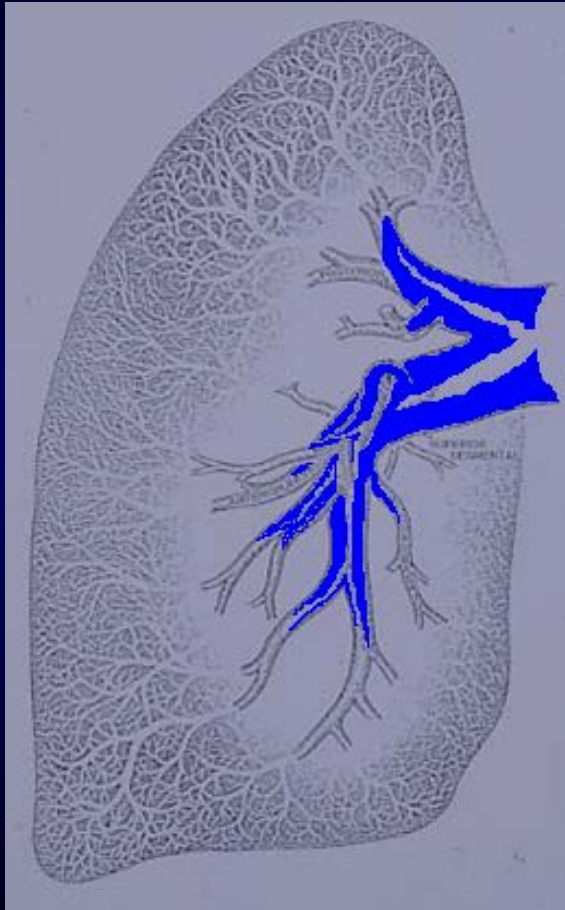
- Gold-standard and curative procedure for CTEPH is PEA
- Different operability percentage in different Centers
- Second opinion is mandatory before judge a patient inoperable

AMOUNT OF PATIENTS

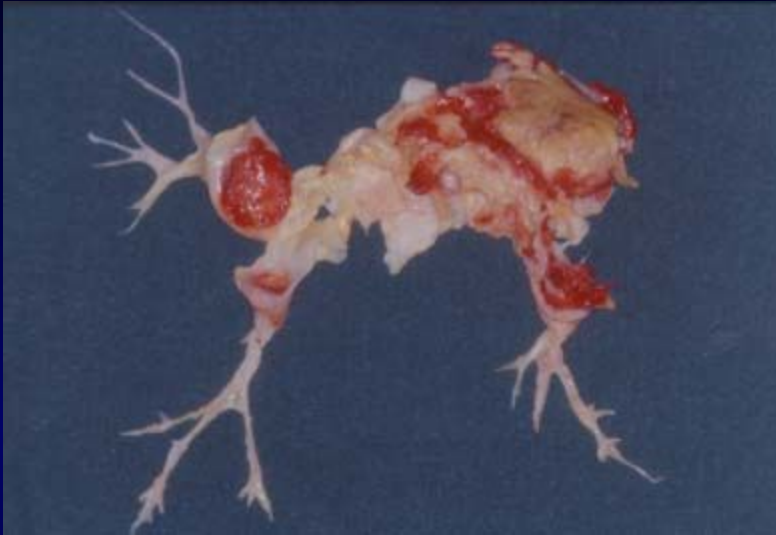
1228 PEAs



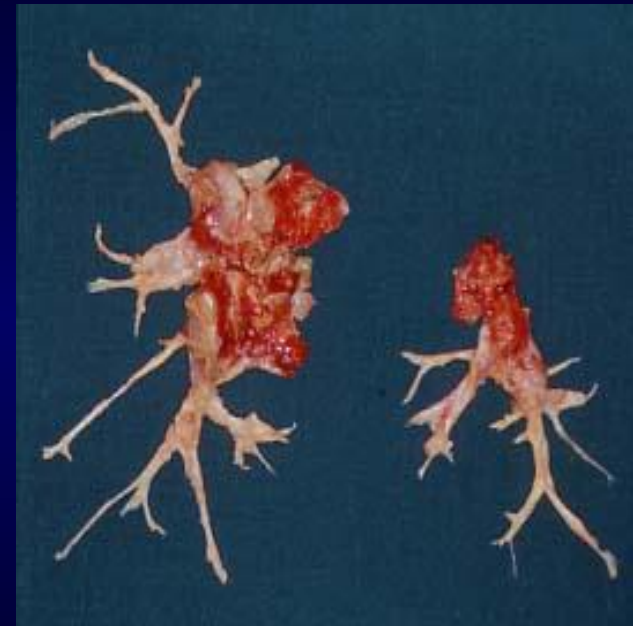
PROXIMAL LESIONS



PROXIMAL SURGICAL SPECIMENS

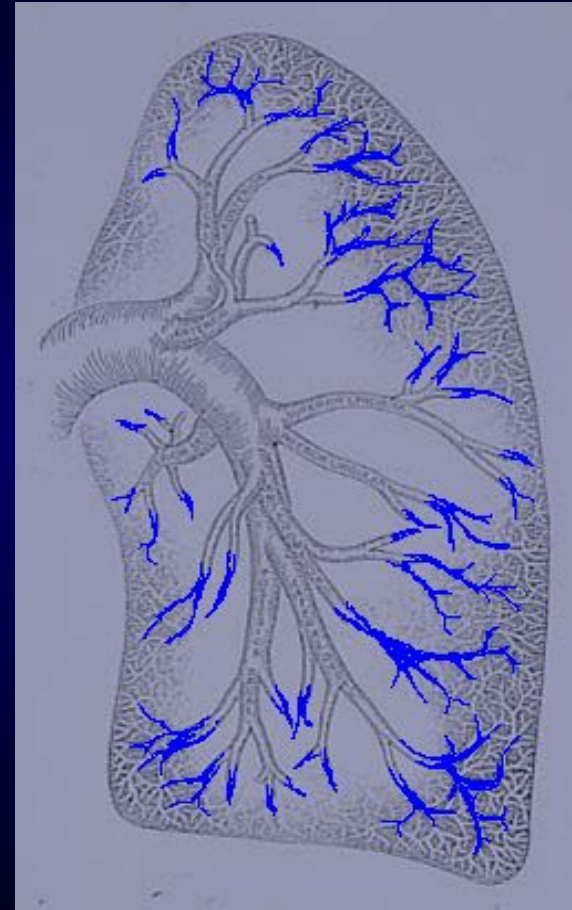
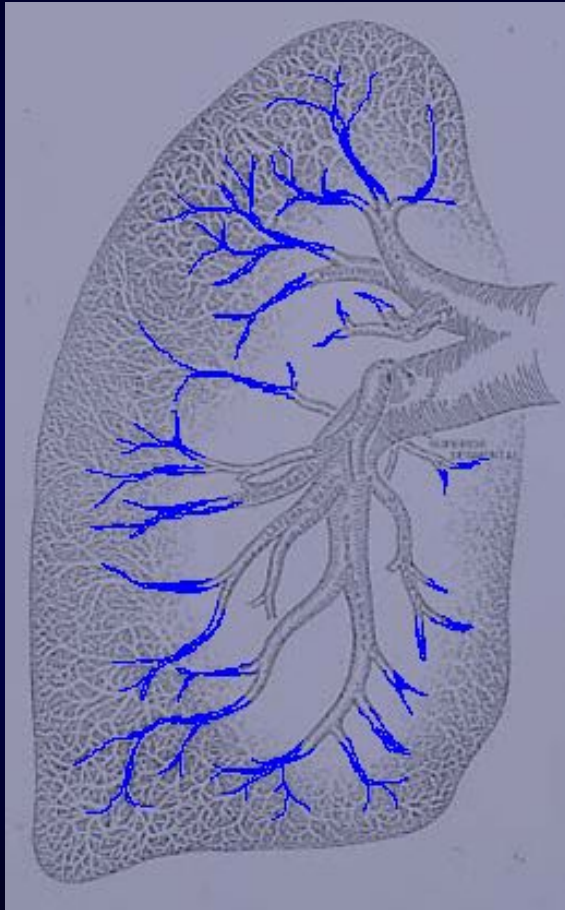


mPAP43 → 20 (-53%)
CO 3.3 → 6.9 (+109%)
PVR 994 → 220 (-78%)



mPAP50 → 25 (-50%)
CO 2.6 → 4.4 (+69%)
PVR 1385 → 364 (-74%)

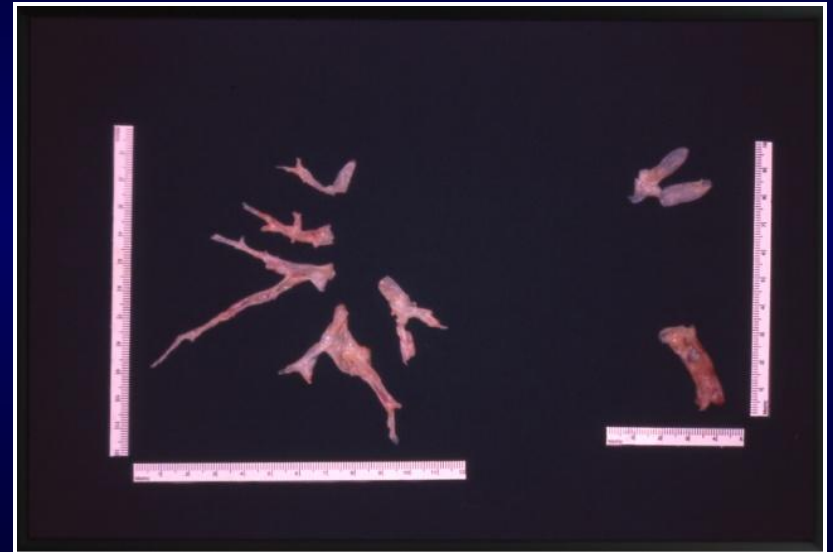
DISTAL LESIONS



DISTAL SURGICAL SPECIMENS



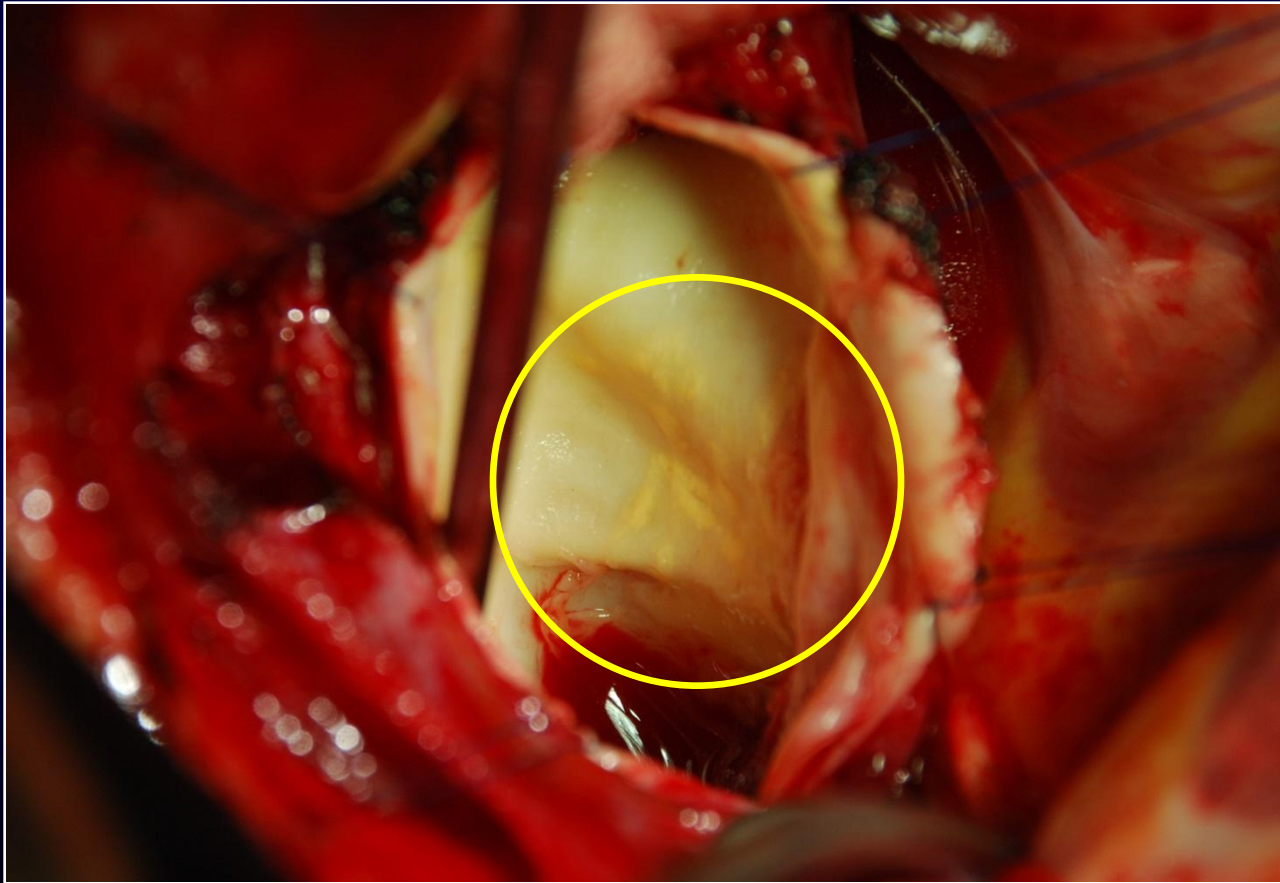
mPAP48 → 27 (-44%)
CO 2.1 → 4.2 (+100%)
PVR 1638 → 381 (-77%)



mPAP 49 → 19 (-61%)
CO 3.3 → 5.0 (+52%)
PVR 1067 → 224 (-79%)

CORRECT ARTERIAL DISSECTION PLANE

Yellow-fibro-lipid plaques included into the removed cast



CORRECT ARTERIAL DISSECTION PLANE

Reverse Ariadne's thread

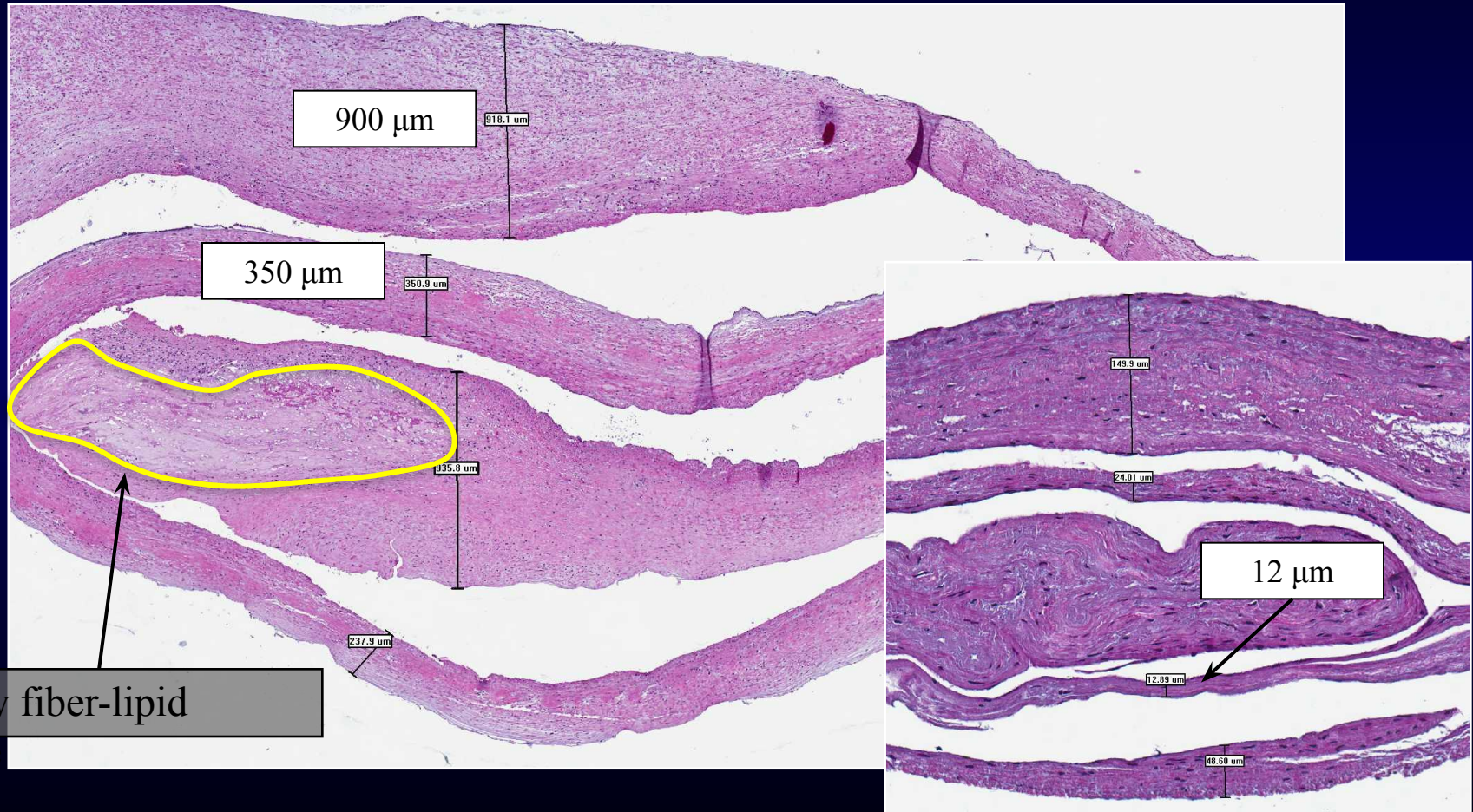


SURGICAL SPECIMENS



TRICKS AND TIPS

Proximal dissection for the clearance of distal obstructions



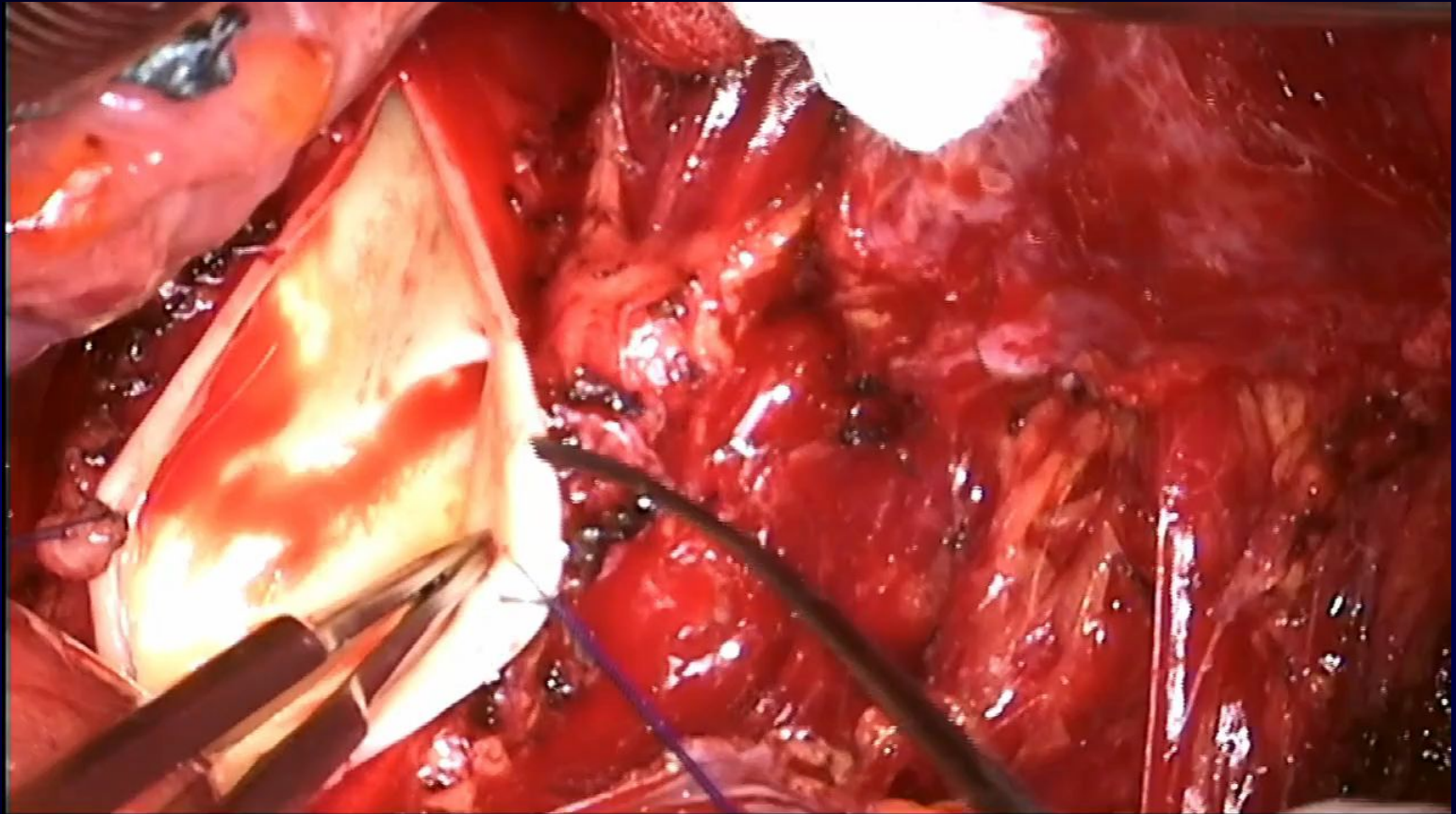
TRICKS AND TIPS

Proximal dissection for the clearance of distal obstructions



Sample





EVOLVING SURGICAL TECHNIQUE



Editorial

Surgical management of pulmonary endarterectomy avoiding deep hypothermia: the Pavia experience

Andrea M. D'Armini^{1,2}, Anna Celentano¹, Alessia Alloni³, Giuseppe Silvaggio³, Cristian Monterosso³, Carlo Pellegrini^{1,3}, Stefano Ghio⁴

¹Department of Clinical, Surgical, Pediatric and Diagnostic Sciences, University of Pavia School of Medicine, Italy; ²Division of Cardiac Surgery 2 and Pulmonary Hypertension Center, Foundation I.R.C.C.S. Policlinico San Matteo, Pavia, Italy; ³Division of Cardiac Surgery 1, Foundation I.R.C.C.S. Policlinico San Matteo, Pavia, Italy; ⁴Division of Cardiology, Foundation I.R.C.C.S. Policlinico San Matteo, Pavia, Italy

Correspondence to: Andrea M. D'Armini, MD. Division of Cardiac Surgery 2 and Pulmonary Hypertension Center, Foundation I.R.C.C.S. Policlinico San Matteo, Viale Golgi 19, 27100 Pavia, Italy. Email: andreamaria.darmini@unipv.it; a.darmini@smatteo.pv.it.



Submitted Nov 16, 2021. Accepted for publication Dec 17, 2021.

doi: 10.21037/acs-2021-pte-22

View this article at: <https://dx.doi.org/10.21037/acs-2021-pte-22>



ANNALS OF CARDIOTHORACIC SURGERY

SURGICAL PROTOCOL

TAILORED AND LESS INVASIVE SURGERY

Since 15-10-2009 (#245)

	Original San Diego protocol	Actual Pavia protocol
Aortic clamp	Yes	No
Cardioplegia	Yes	No
Hypothermia	Deep (18°C)	Moderate (24°C)
Circulatory arrest	A single (20 minutes) period of circulatory arrest for each side (with a maximum of a third)	Intermittent short periods of circulatory arrest (\approx 7-10 minutes) followed by short re-perfusion periods (\approx 5-7 minutes)
Total arrest time	Maximum 60 minutes	Maximum 180 minutes

SURGICAL PROTOCOL



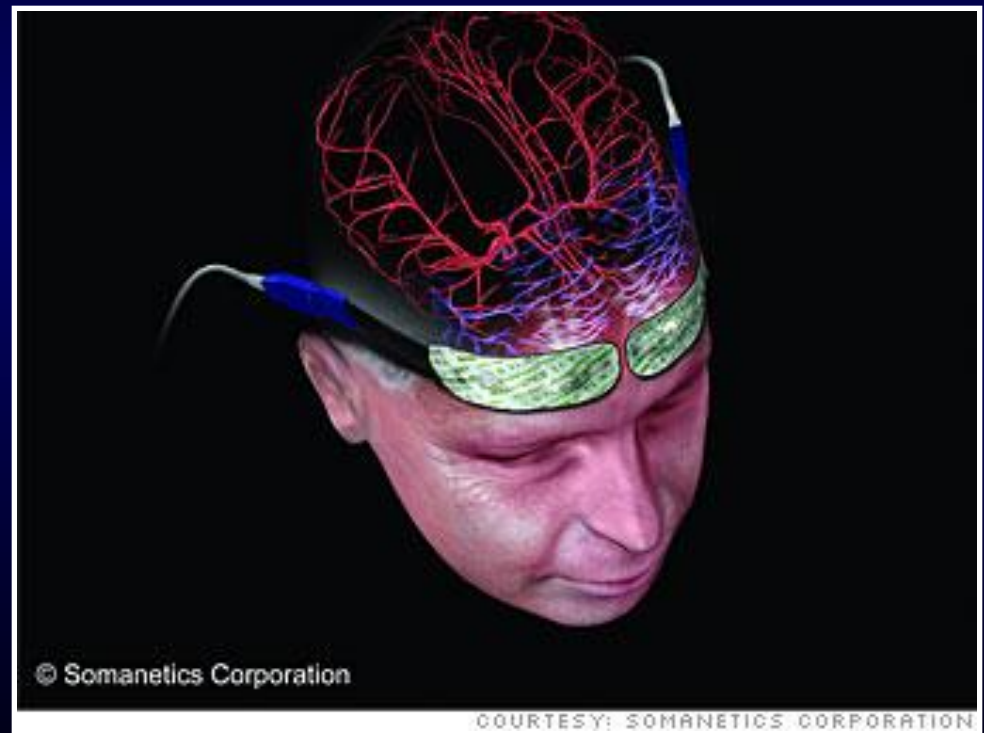
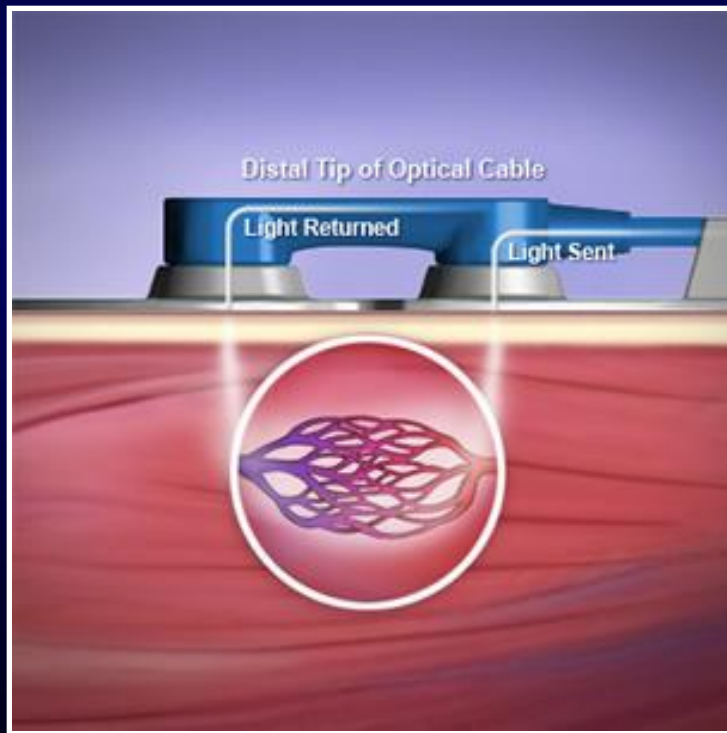
Up today more than 975 PEAs performed with this technique

CEREBRAL PROTECTION STRATEGY

NIRS MONITORING

Near-InfraRed Spectroscopy

Clinical application

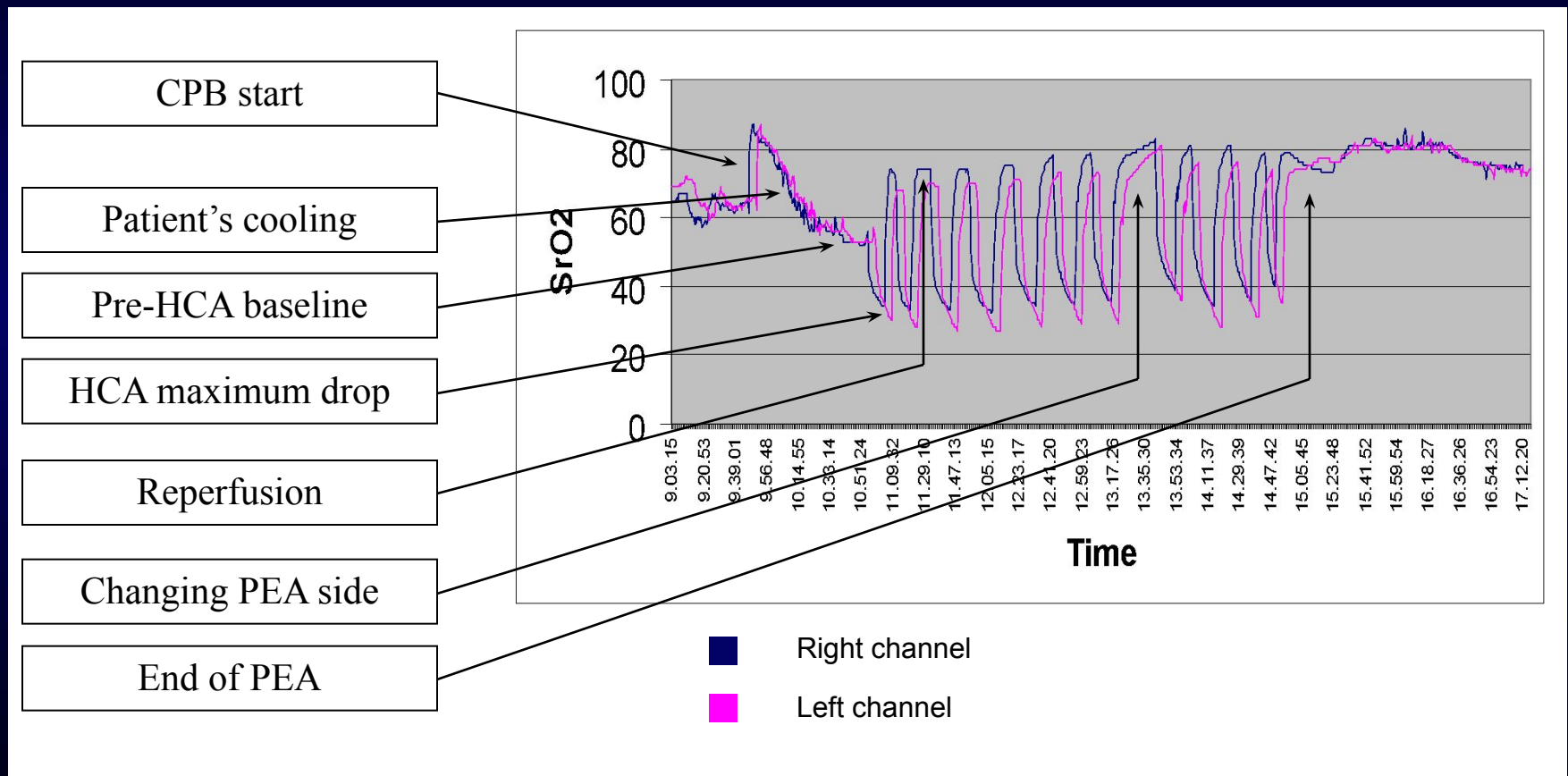


COURTESY: SOMANETICS CORPORATION

CEREBRAL PROTECTION STRATEGY

NIRS MONITORING

Near-InfraRed Spectroscopy



TREATED BRANCHES AND OUTCOME

International Journal of Cardiology

PULMONARY ENDARTERECTOMY IN CHRONIC THROMBOEMBOLIC
PULMONARY HYPERTENSION: RELATIONSHIP BETWEEN TREATED BRANCHES
AND OUTCOME

--Manuscript Draft--

Andrea M. D'Armini^{1 2}, Maurizio Pin¹, Anna Celentano¹, Leslie Joyce Te Masiglat¹, Ermelinda Borrelli¹,
Benedetta Vanini¹, Catherine Klersy³, Giuseppe Silvaggio⁴, Cristian Monterosso⁴, Alessia Alloni⁴, Carlo
Pellegrini^{1 4}, Stefano Ghio⁵.

International Journal of
CARDIOLOGY

BACKGROUND

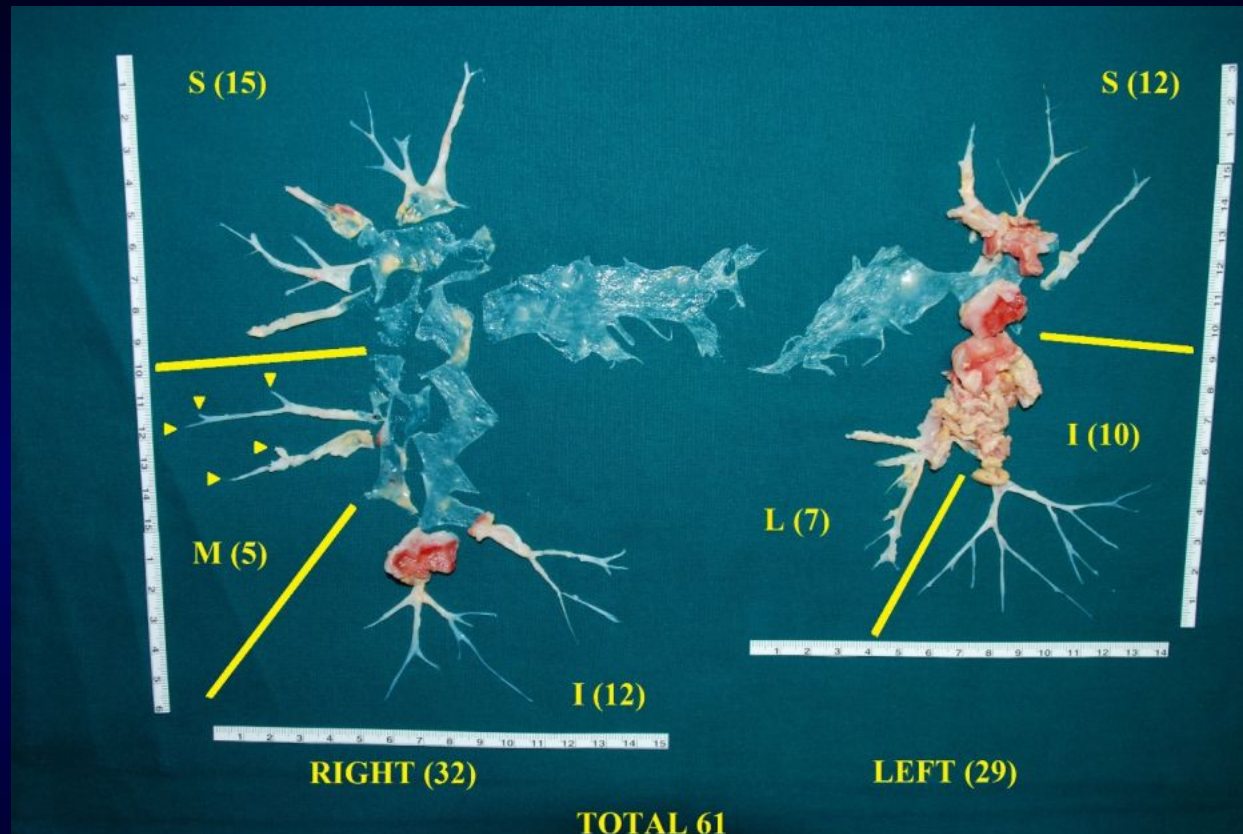
In patients with CTEPH undergoing PEA it is important to minimize residual obstructions, in order to achieve low postoperative pulmonary vascular resistances and better clinical results

METHODS

In 564 consecutive CTEPH pts undergoing PEA the count of the number of treated branches was performed directly on the surgical specimens

Post-operative FUP visits were scheduled at 3 months and 12 months after surgery including right heart catheterization and modified Bruce test

ANALYSIS OF PEA SPECIMEN



Surgical specimen of a patient with a Jamieson 1 disease. A total of 32 branches were treated in the right lung and 29 in the left lung. The arrows indicate how 5 treated branches were counted in the middle lobe of the right lung
S= superior lobe, M = middle lobe, I = inferior lobe, L = lingula

POPULATION

The population was divided into tertiles based on the number of treated branches

Group 1	from 4 to 30 treated branches	194 patients
Group 2	from 31 to 43 treated branches	190 patients
Group 3	from 44 to 100 treated branches	180 patients

RESULTS AT 3 AND 12 MONTHS AFTER PEA

Patients in the third tertile of treated branches had significantly lower values of PVR and higher values of pulmonary arterial compliance (PCa) as compared to the other two groups

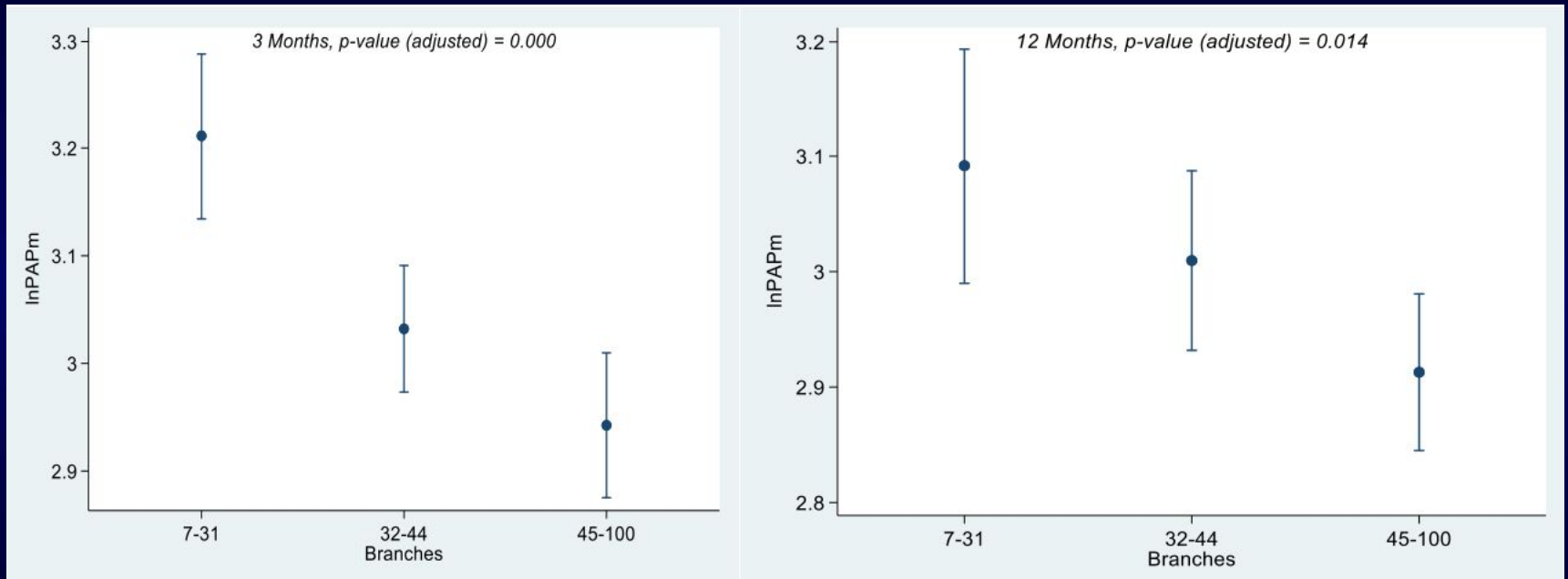
Patients in the second and third tertile of treated branches had similar values of mPAP and PaO₂ and significantly better than those in the first tertile

RESULTS AT 3 AND 12 MONTHS AFTER PEA

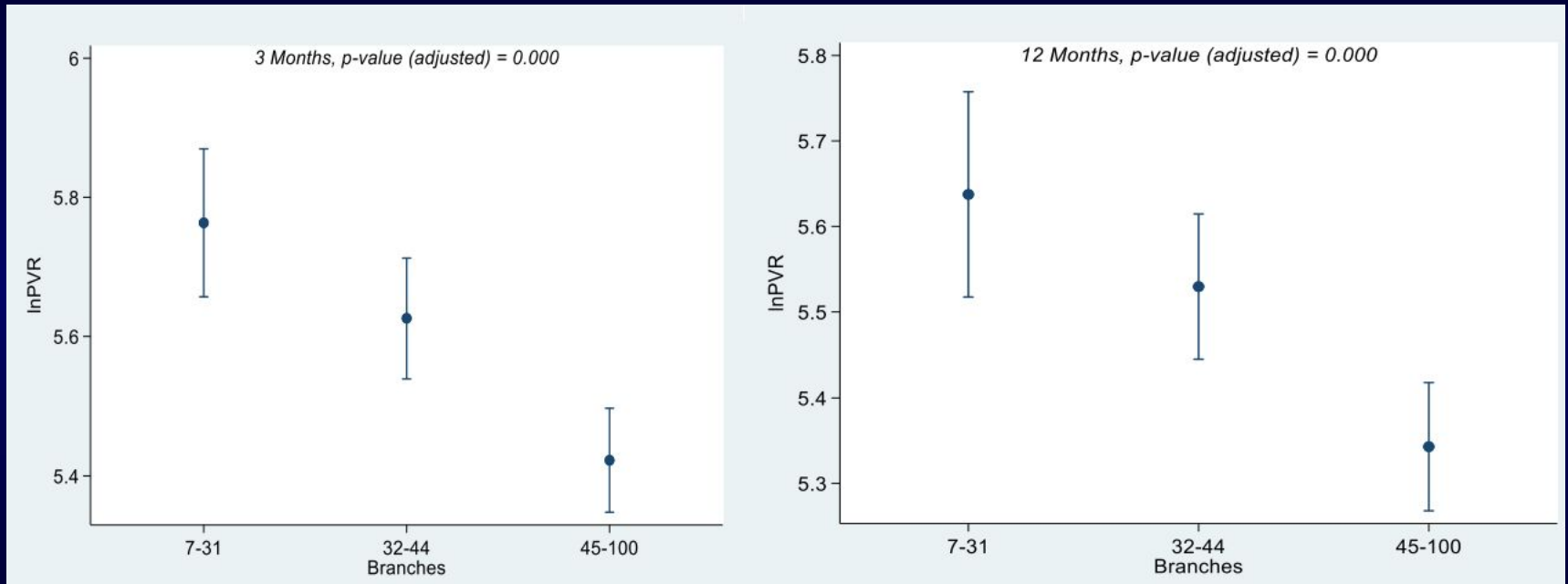
Patients in the second and third tertile were all in WHO class I or II

A greater proportion of patients in the third tertile was able to walk more than 400 meters at the modified Bruce test than in the other two groups

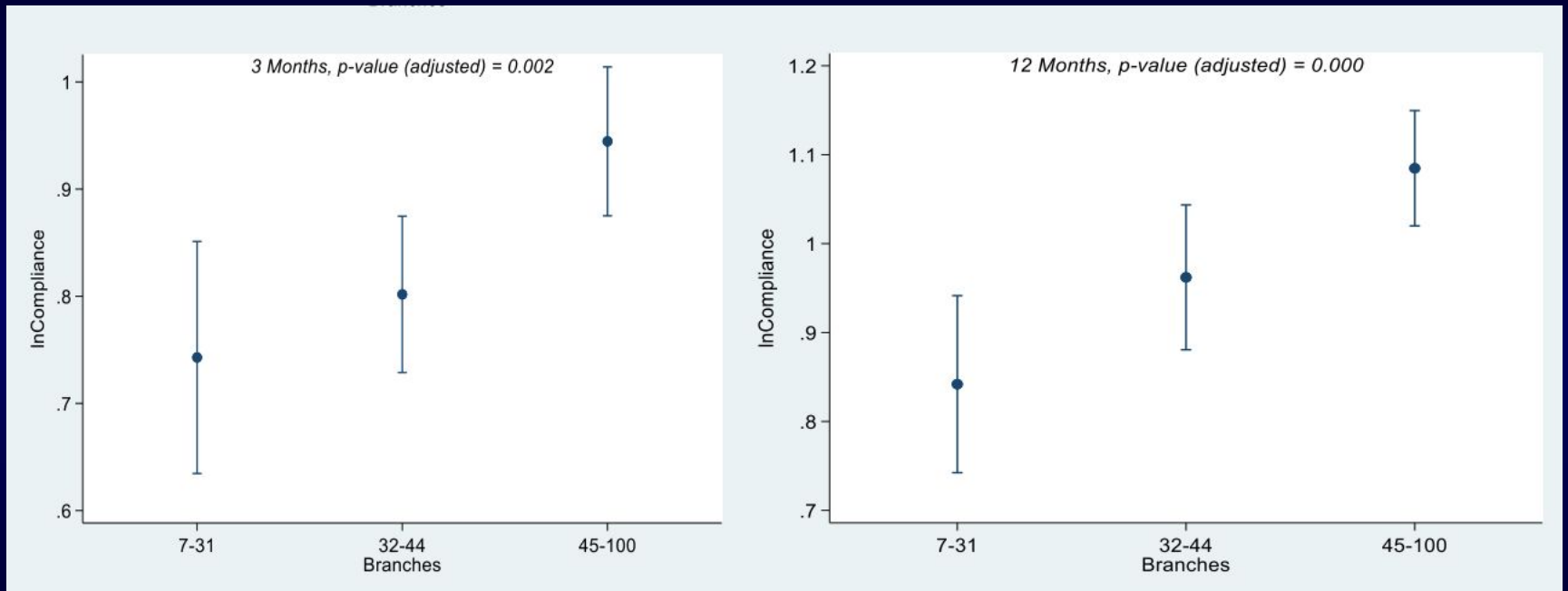
MPAP AT 3 AND 12 MONTHS AFTER PEA



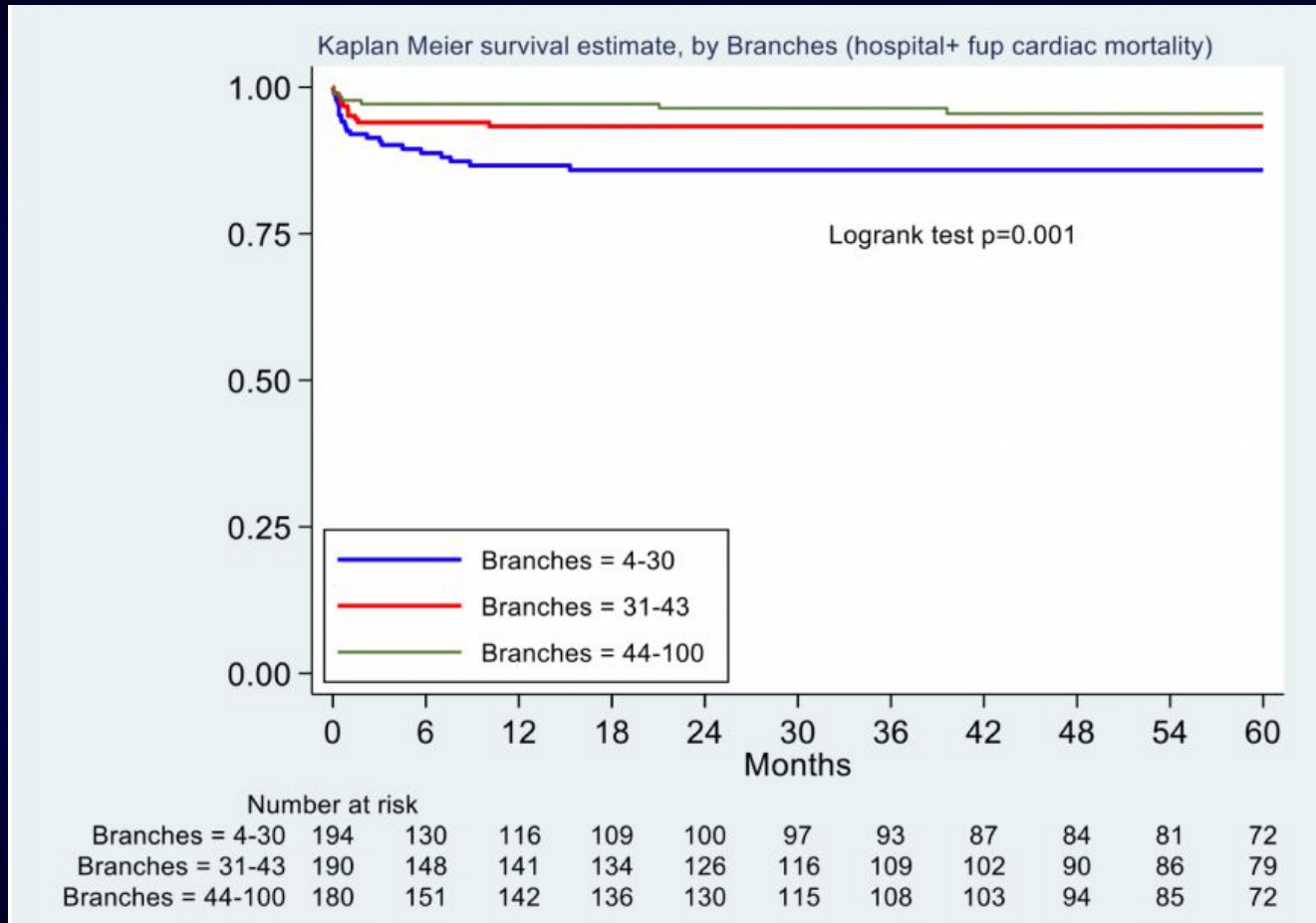
PVR AT 3 AND 12 MONTHS AFTER PEA



PCa AT 3 AND 12 MONTHS AFTER PEA



LONG-TERM SURVIVAL



SPECIFIC MEDICAL TREATMENT AFTER PEA

	DISCONTINUATION	INTRODUCTION
Group 1	40%	7%
Group 2	85%	4%
Group 3	97%	2%

CONCLUSIONS

In our hands a longer total circulatory arrest time (average 95 minutes) allows the surgeon to explore all the pulmonary vascular bed, find unexpected chronic thromboembolic material and clean more branches even in more complex clinical conditions as well as in distal vassels

CONCLUSIONS

- In CTEPH patients undergoing PEA, a higher number of treated pulmonary artery branches is associated with
- lower hospital mortality
 - better hemodynamic and functional outcome at 3 months and 12 months
 - better long-term outcome