PEA surgery for CTEPH

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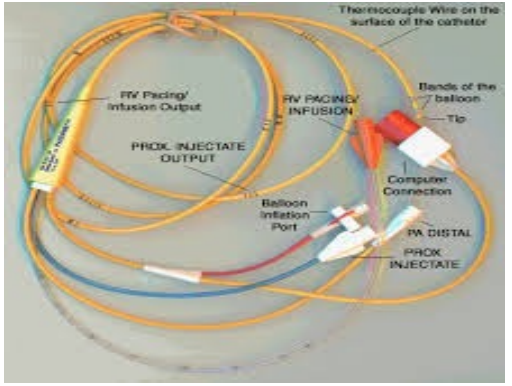
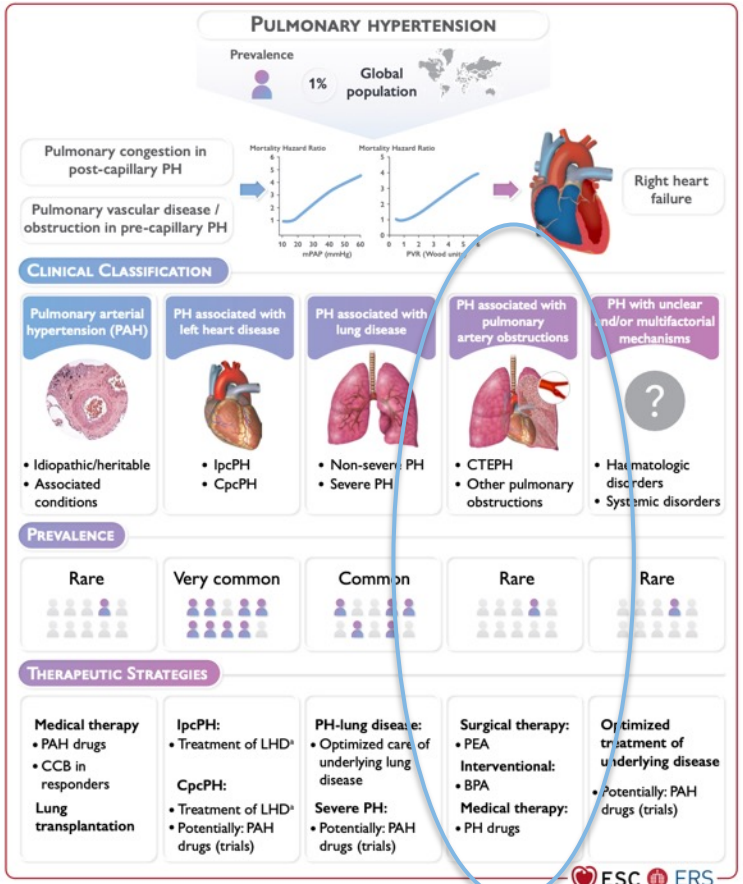
Pulmonary hypertension

Medical textbook definition mPAP ≥ 25 mmHg

New definition (6thWSPH mPAP > 20 mmHg PVR ≥ 2W)



Classification of PH



Humbert et al Eur Heart J 2022

CTEPH introduction

- An obstruction in pulmonary arterial circulation, resulting from incomplete resolution of pulmonary embolism leading to pulmonary arterial hypertension, wedge < 15 mmHg, diagnosed after 3 months anticoagulation.
- Not all patients with CTEPH have a history of DVT/PE. Main symptoms non-specific, SOBOE and fatigue. Often delayed diagnosis.
- Most treatable form of PH in 2024, now 3 modalities available.

Kim N. 6thWSPH *Eur Resp J* 2019.

1000th Great Britain and Ireland Pulmonary Endarterectomy - Celebratory Meeting

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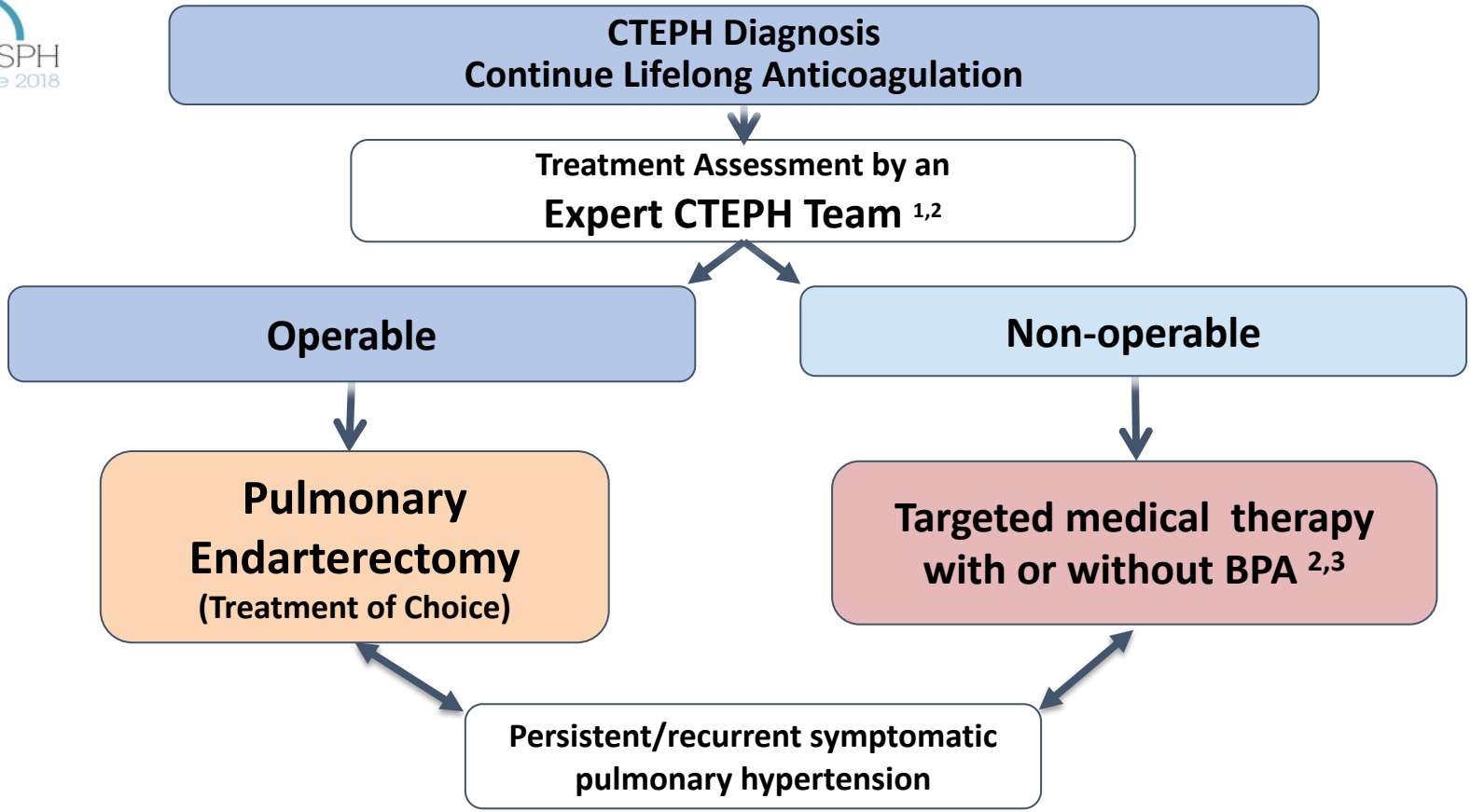
6WSPH recommendations



Kim et al 6WSPH Eur Resp J 2019

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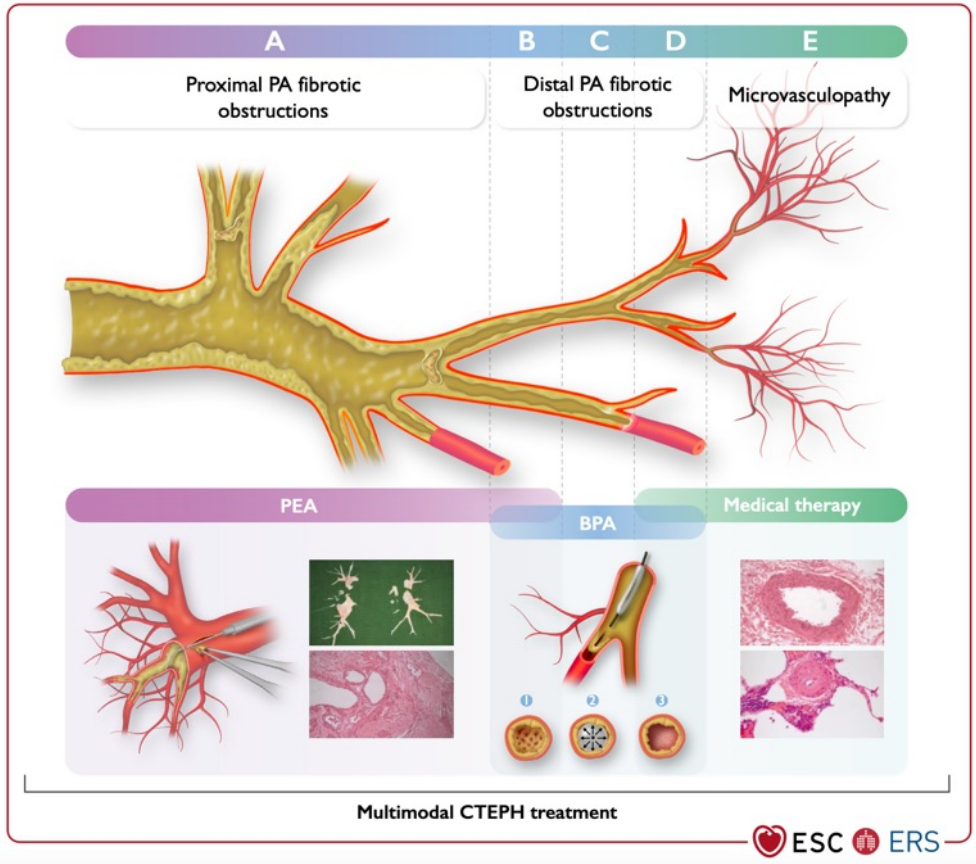
New guideline CTEPH treatment recommendations

PEA is recommended as the treatment of choice for patients with CTEPH and fibrotic obstructions within pulmonary arteries accessible by surgery[54,102]	I	B
BPA is recommended in patients who are technically inoperable or have residual PH after PEA and distal obstructions amenable to BPA[54,102,783,784,789,793,798,811]	I	B
Riociguat is recommended for symptomatic patients with inoperable CTEPH or persistent/recurrent PH after PEA[775]	I	B
PEA or BPA should be considered in selected symptomatic patients with CTEPD without PH	IIa	C
BPA may be considered for technically operable patients with a high proportion of distal disease and an unfavourable risk:benefit ratio for PEA	IIb	C

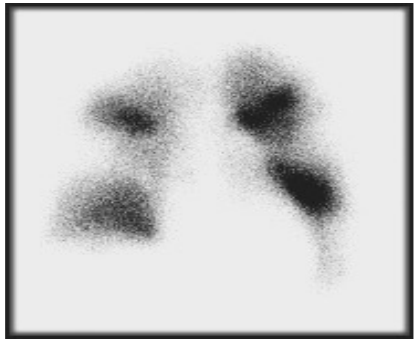
Humbert et al *Eur Heart J* 2022

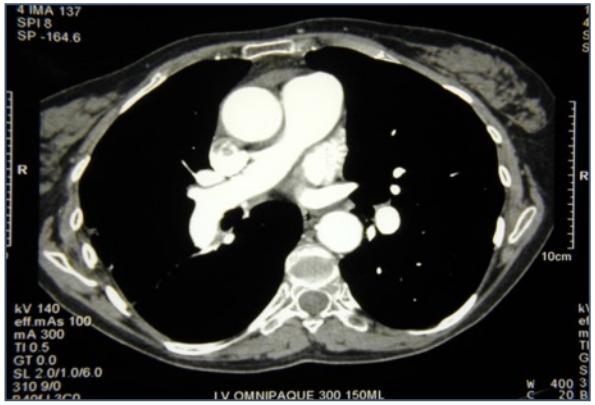
Multimodality treatment, site of action

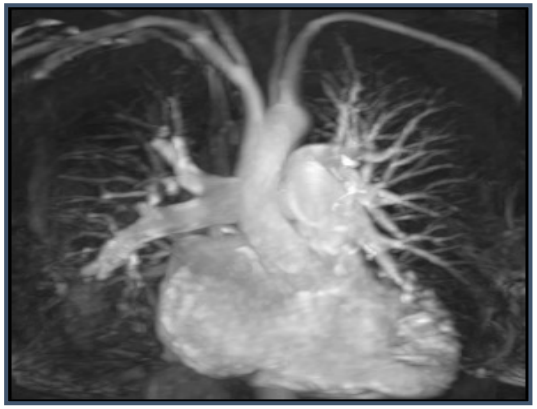


Humbert et al *Eur Heart J* 2022.

Imaging for diagnosis of CTEPH

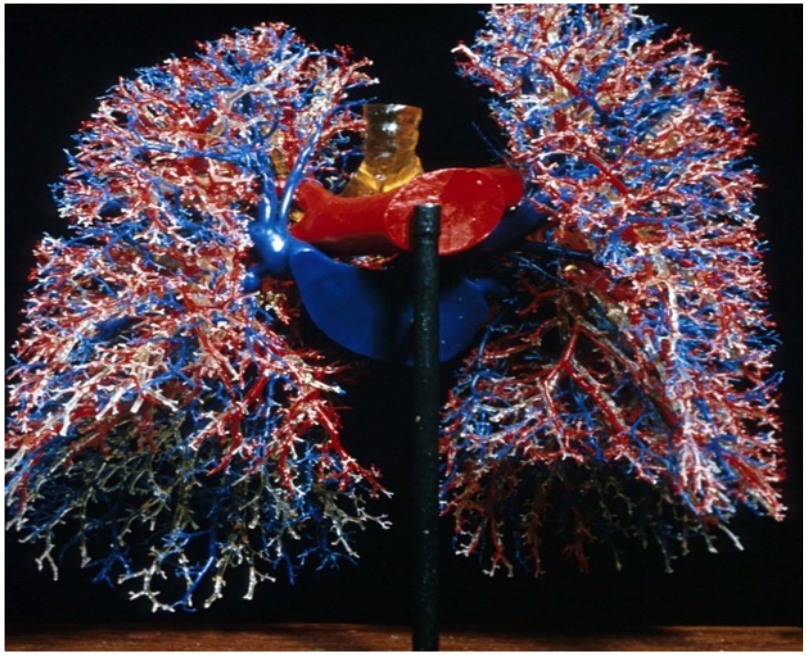






Hoey ET. *Am J Roentgenol.* 2011;196(3):524

Anatomy and physiology of pulmonary arteries

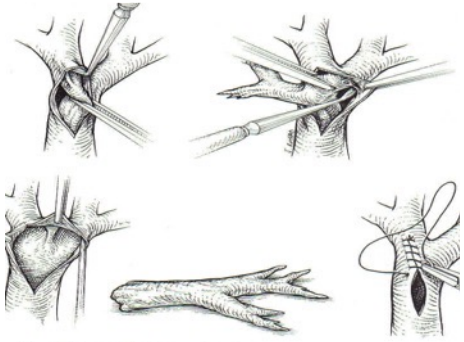


Difficulties to overcome:

- Central location PA
- 5L/min blood flow
- Thin walled vessel
- Dual circulation, bronchial and PA

Difference between heart surgery and other surgery?

Time limitation with PEA due to DHCA



Surgical technique PEA/PTE

- Principle simple - clearance of PA obstruction to reduce PVR.
  - Median sternotomy incision, for approach to both lungs.
  - Cardiopulmonary bypass, with cooling to 20^{o}C, (circulatory arrest for <20 mins). Problem of collateral flow.
  - True endarterectomy with full distal dissection into every segmental vessel bilaterally.
  - Concomitant cardiac procedures performed while rewarming (20% of cases > 70 years age). TV surgery usually unnecessary.

Madani M, Jamieson S. *Oper Tech Thorac Cardiovasc Surg* 2006;11:264.

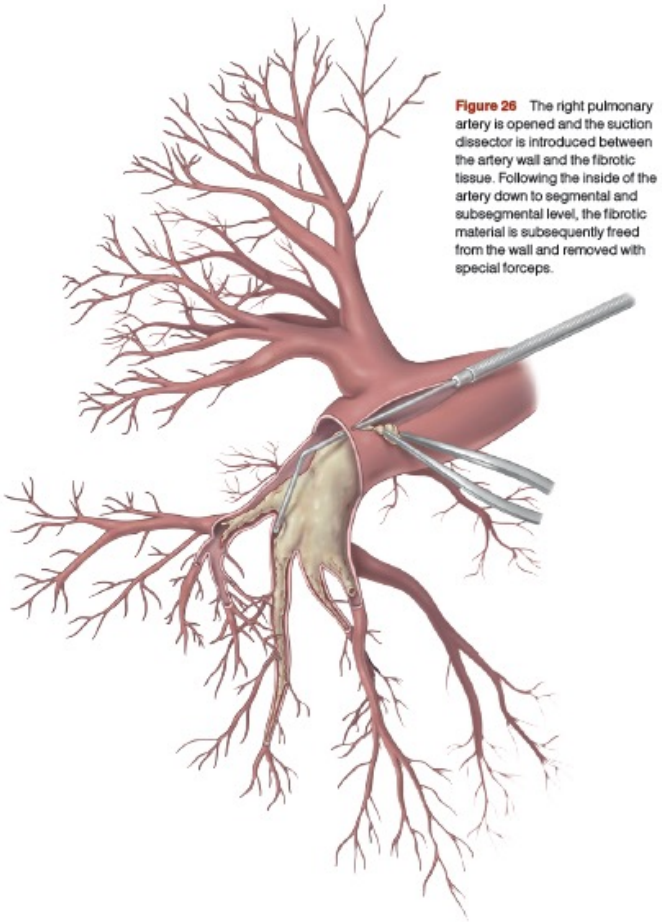
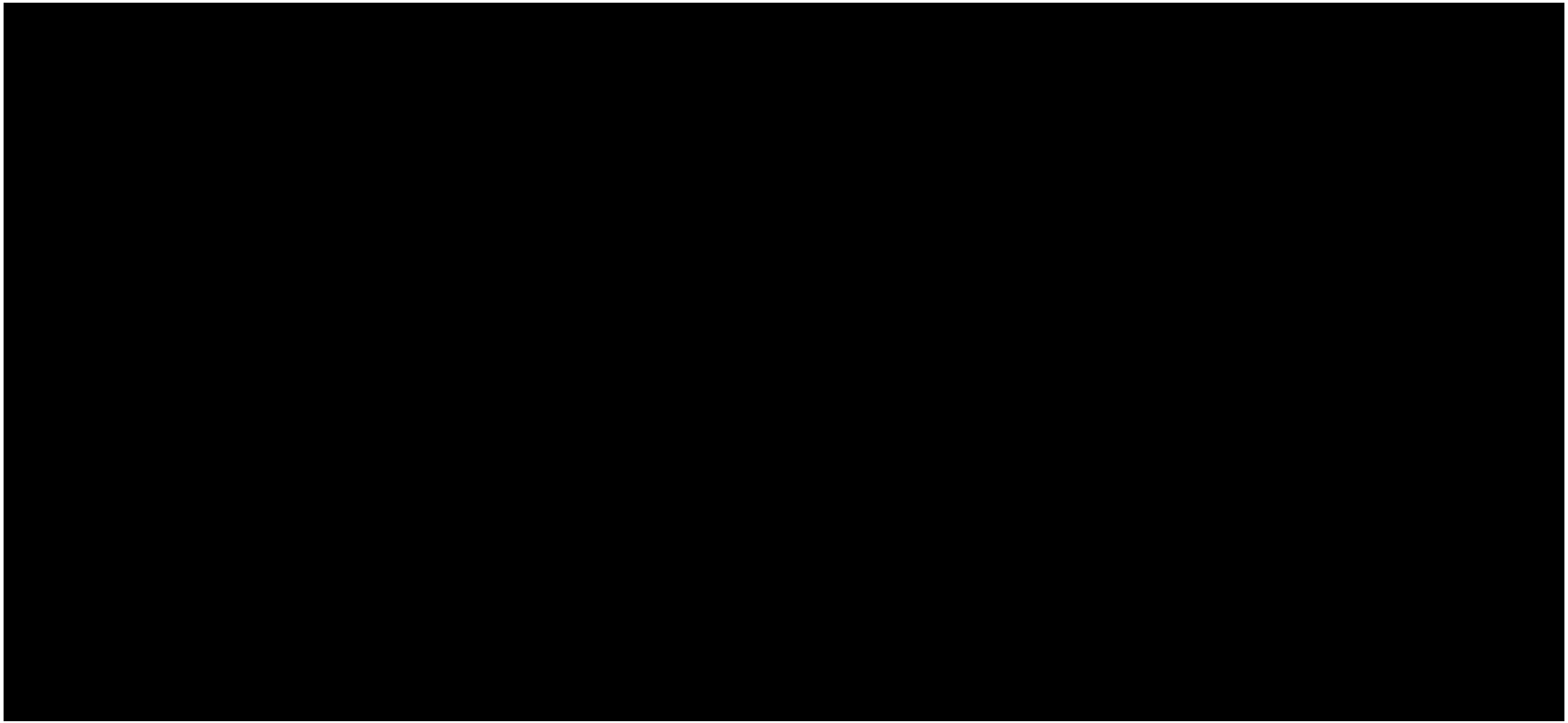


Figure 26 The right pulmonary artery is opened and the suction dissector is introduced between the artery wall and the fibrotic tissue. Following the inside of the artery down to segmental and subsegmental level, the fibrotic material is subsequently freed from the wall and removed with special forceps.

Illustration courtesy of Hotten, M. Thesis, Master Scientific Illustration

PEA surgery



RPH peri-operative outcome by quartile

RPH series by quartile

Peri-op haemodynamics and mortality

	Cohort 1 (01/97–11/ 09) n=529	Cohort 2 (11/09 – 10/13) n=529	Cohort 3 (11/13 – 12/16) n=529	Cohort 4 (12/16 – 09/19) n=529	
Operations per year	41.7	138.6	171.9	199.1	<0.001[a]
Age (years)	56.3	58.9	59.2	58.7	<0.001[a]
Mean PA pressure preop. (mmHg)	49.1	48.4	47.1	46.3	0.009[a]
Mean PA pressure postop (mmHg)	28.1	25.6	24.3	22.4	<0.001[a]
% decrease in mean PA pressure	42.7	47.1	48.4	51.6	<0.001[a]
Mean PVR preop (dynes/sec/cm-5)	615.2	631.4	647.6	671.8	<0.001[a]
Mean PVR postop (dynes/sec/cm-5)	247.4	265.6	267.4	242.2	0.06[a]
% decrease in PVR	59.8	58.0	58.7	63.9	<0.001[a]
30-day mortality	12.3%	4.0%	3.4%	1.9%	<0.001[b]
1-year survival	86.3%	91.8%	92.6%	92.4%	0.006[b]

Reduction in mPA by 50%

Reduction in PVR by > 60%

Latest mortality < 2%

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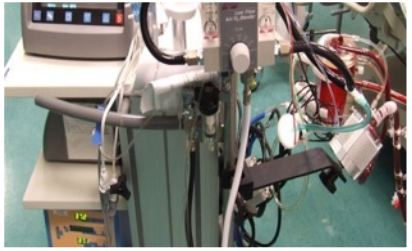
Complications of PEA

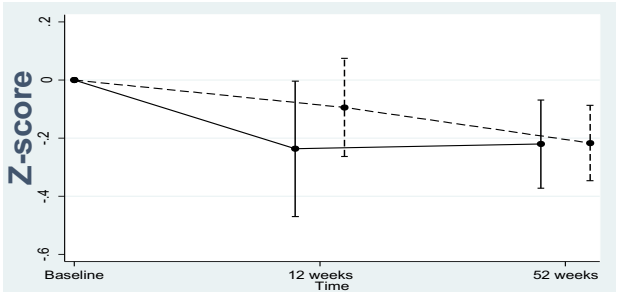
- Multiple complications possible following surgery, infections, bleeding etc
- Main serious complications specific to PEA:
  - Airway haemorrhage
  - Reperfusion lung injury
  - Residual PH, RV failure, low CO
  - Neurological injury
- Many now salvageable by ECMO.



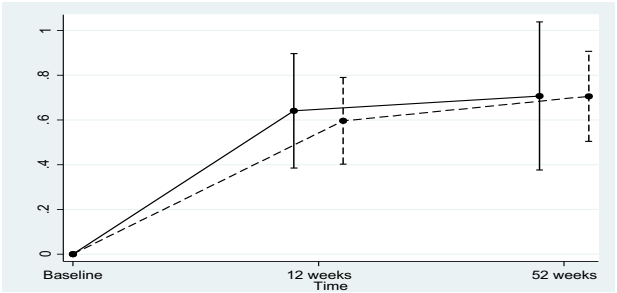
RCT proven safety of DHCA without cognitive decline

Circulatory arrest versus cerebral perfusion during pulmonary endarterectomy surgery (PEACOG): a randomised controlled trial

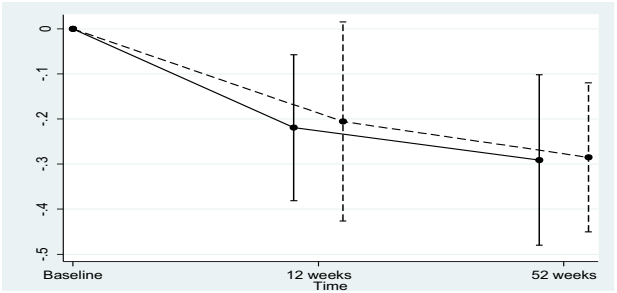
Alain Vuylsteke, Linda Sharples, Gill Charman, John Kneeshaw, Steven Tsui, John Dunning, Ella Wheaton, Andrew Klein, Joseph Arrowsmith, Roger Hall, David Jenkins**



Trailmaking



Rey auditory



Grooved peg board

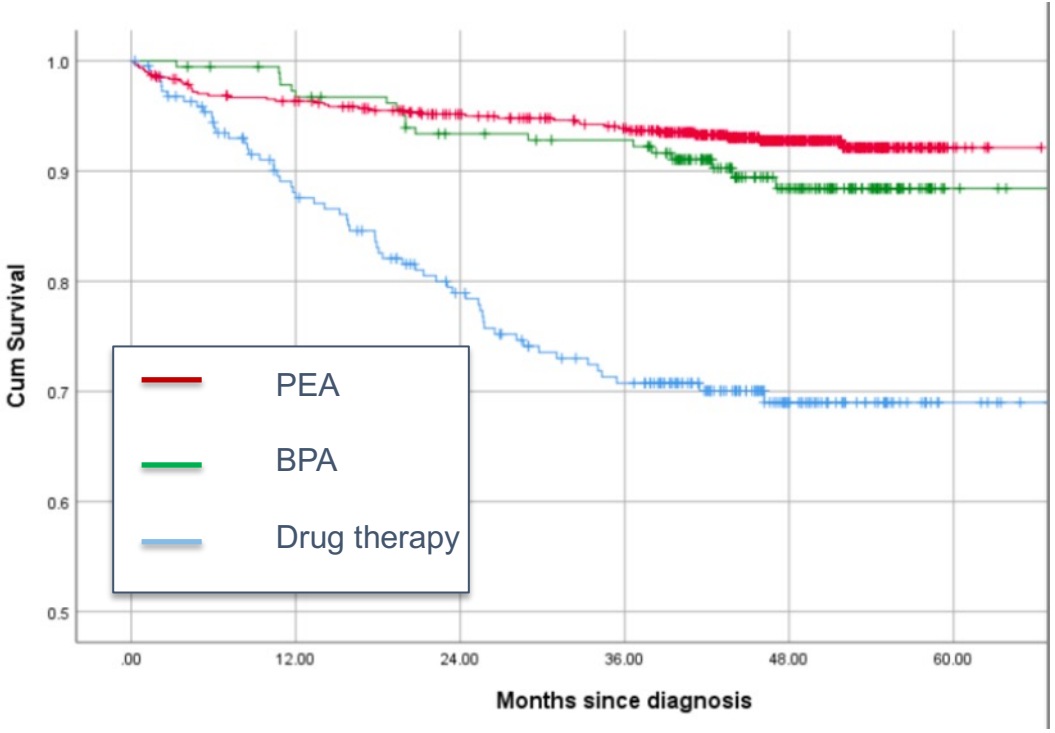
DHCA SACP

DHCA, deep hypothermic circulatory arrest; SACP, selective antegrade cerebral perfusion.

Vuylsteke A. *Lancet* 2011;378:1379.

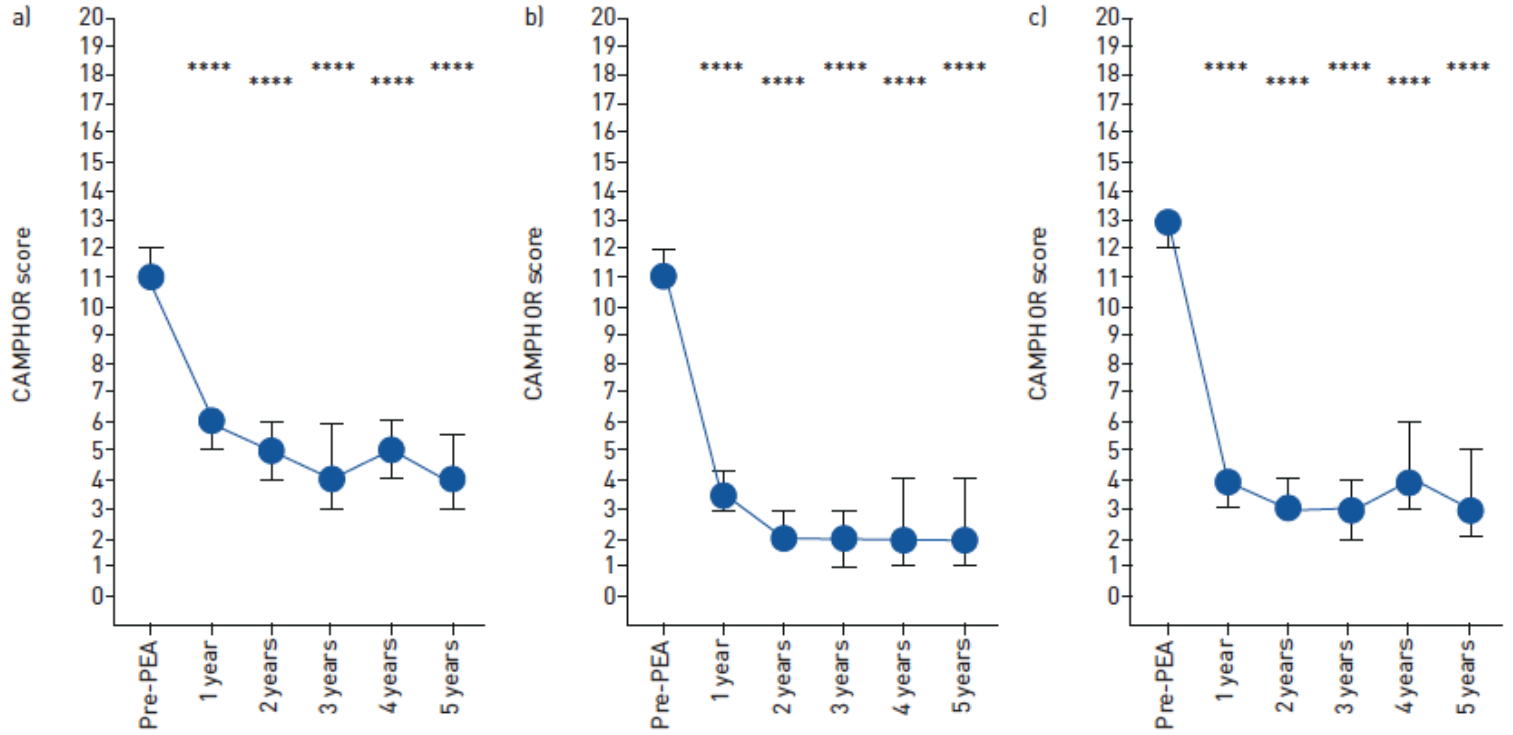
Survival according to treatment

New ICA International CTEPH registry



New International CTEPH Registry.

Activity, quality of life and symptoms after PEA



Newham Euro Resp J 2020

Conclusions

- PEA role clear, it is the guideline recommended first line treatment for CTEPH, and still accounts for the majority of interventions.
- Operation reproducible with mortality ~2% in experienced units.
- Immediate improvement in haemodynamics.
- Specific complications, treatable with ECMO.
- Successful early outcomes translate into sustained improvement in quality of life and long term survival.
- PEA surgery can be part of a multimodality strategy for some patients.

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Thank you

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