3rd Annual Symposium
PULMONARY EMBOLISM
What Is Known, and What We Need to Know
State-of-the-Art and Scientific Update

June 23–24, 2017
Royal Sonesta Boston
40 Edwin H. Land Boulevard
Cambridge, MA
CTEPH in Depth: A Tale of Three Patients

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Disclosures

• Co-Investigator, National CTEPH Registry, Grant by Bayer
• Advisory member, CTEPH Imaging Expert Panel (IEP) Bayer sponsored
Factors considered in CTEPH operability assessment

- Reliable and Interpretable Imaging
- Surgeon experience, patient volume, outcomes, distal disease

Operability
Factors considered in CTEPH operability assessment

- Reliable and Interpretable Imaging
- Surgeon experience, patient volume, outcomes, distal disease
- Clot burden
- Hemodynamics
- Surgical Candidate
- Center experience
- Patient factors: age, comorbidities, technical
diagnosis of acute PE, planar V/Q lung scan remains the main first-line imaging modality for CTEPH, as it carries a 96–97% sensitivity and a 90–95% specificity for the diagnosis.

In contrast, in IPAH and PVOD, perfusion scans typically show non-segmental defects or are normal.

More recent work suggests that both V/Q scanning and modern CT pulmonary angiography may be accurate methods for the detection of CTEPH, with excellent diagnostic efficacy in expert hands (100% sensitivity, 93.7% specificity and 96.5% accuracy for V/Q and 96.1%, 95.2% and 95.6%, respectively, for CT pulmonary angiography).

Multidetector CT pulmonary angiography has become an established imaging modality for confirming CTEPH, however, this investigation alone cannot exclude the disease.

CT pulmonary angiography may help to identify complications of the disease such as PA dilatation resulting in left main coronary artery compression and hypertrophied bronchial arterial collaterals, which may lead to haemoptysis.

A high-resolution CT scan of the chest delivers images of the lung parenchyma and identifies emphysema, bronchial disease or interstitial lung disease, as well as infarcts, vascular and pericardial malformations and thoracic wall deformities. Perfusion inequalities manifest as a mosaic parenchymal pattern, with dark areas corresponding to relatively decreased perfusion. Although a mosaic pattern is frequent in CTEPH, it can also be observed in up to 12% of patients with PAH.

MR imaging of the pulmonary vasculature is still considered inferior to CT, but this modality, as well as cone beam CT, angioscopy, intravascular ultrasound or optical coherence tomography, may be complimentary and used according to local experience and practice.

RHC is an essential diagnostic tool. Preoperative and immediate postoperative PVR is a long-term predictor of prognosis.

The final step in the diagnostic pathway is selective pulmonary angiography in the anterior–posterior and lateral projections illustrating ring-like stenosis, webs ('slits'), pouches, wall irregularities, complete vascular obstructions as well as bronchial collaterals, and supports the technical assessment of operability.

10.2 Therapy

10.2.1 Surgical

PEA is the treatment of choice for CTEPH (Figure 4). In Europe, in-hospital mortality is currently as low as 4.7%, and even lower in...
71 yo male
RLE DVT   Hx Prostate CA   FC III
71 yo male: Pulmonary Angiogram
71 yo male: Pulmonary Angiogram
71 yo male

PVR pre-PTE 1243 to PVR 214 post-PTE
15 yo female

Volleyball player Paget-Schroetter FC III

PE dx by CTA 10/14, placed on AC

RHC (12/14) RA 10, PAp 101/28 (58), Fick CO 4.02
15 yo female: Pulmonary Angiogram
15 yo female: Pulmonary Angiogram
The value of CT.....
Clot size isn’t everything!

Level IV Resection

Preop to Postop PVR:
1091 to 242 d.s.cm\(^{-5}\)
MR Angio
PVR 1169 to 294

PVR 858 to 365

PVR 1290 to 204

PVR 527 to 188
Level III PTE (2013-2015)
N = 96 (18.4%)
Level IV PTE (2013-2015)
N = 35 (6.7%)
27 yo female: the case for BPA

- Cough, progressive DOE 4/16
- Left arm DVT/PE 6/16
- Hx OCPs; no drug use
- Presentation UCSD 12/16
- Echo: severe RVE; Moderate RAE; normal LV
The case for BPA

RA mean 12, PAp 83/34 (52), PCW 10, Fick CO 2.63/Cl 1.54, 16.0 WU
The case for BPA

- Pre BPA PH treatment (macitentan, riociguat)
- 3 BPA sessions
- RA mean 3, PAp 52/20(32), Fick CO 7.76/Cl 3.93, PVR 3.99 (Hemodynamics prior to 4th session)
CTEPH: Treatment Bandwidth

Pulmonary Thromboendarterectomy

Medical Therapy

Angioplasty

Proximal PA  Distal PA

CTEPH: Evolving Surgical Centers?

- Pulmonary Thromboendarterectomy
- Medical Therapy
- Angioplasty

CTEPH: high volume PTE center?

Pulmonary Thromboendarterectomy

Medical Therapy

Angioplasty

Proximal PA

Distal PA

CTEPH: experienced PTE/BPA center?

- Pulmonary Thromboendarterectomy
- Angioplasty
- Medical Therapy

The Challenges Ahead

- Defining the location of CTE disease accurately
- Understanding surgical capabilities
- Selection of patients
  - Inoperable CTEPH patients
  - High risk, even with operable CTE disease
  - Symptomatic CTED, with appropriate lesions
- Understanding long-term outcomes
- BPA as a hybrid approach to Rx CTEPH (pre- vs postoperatively)