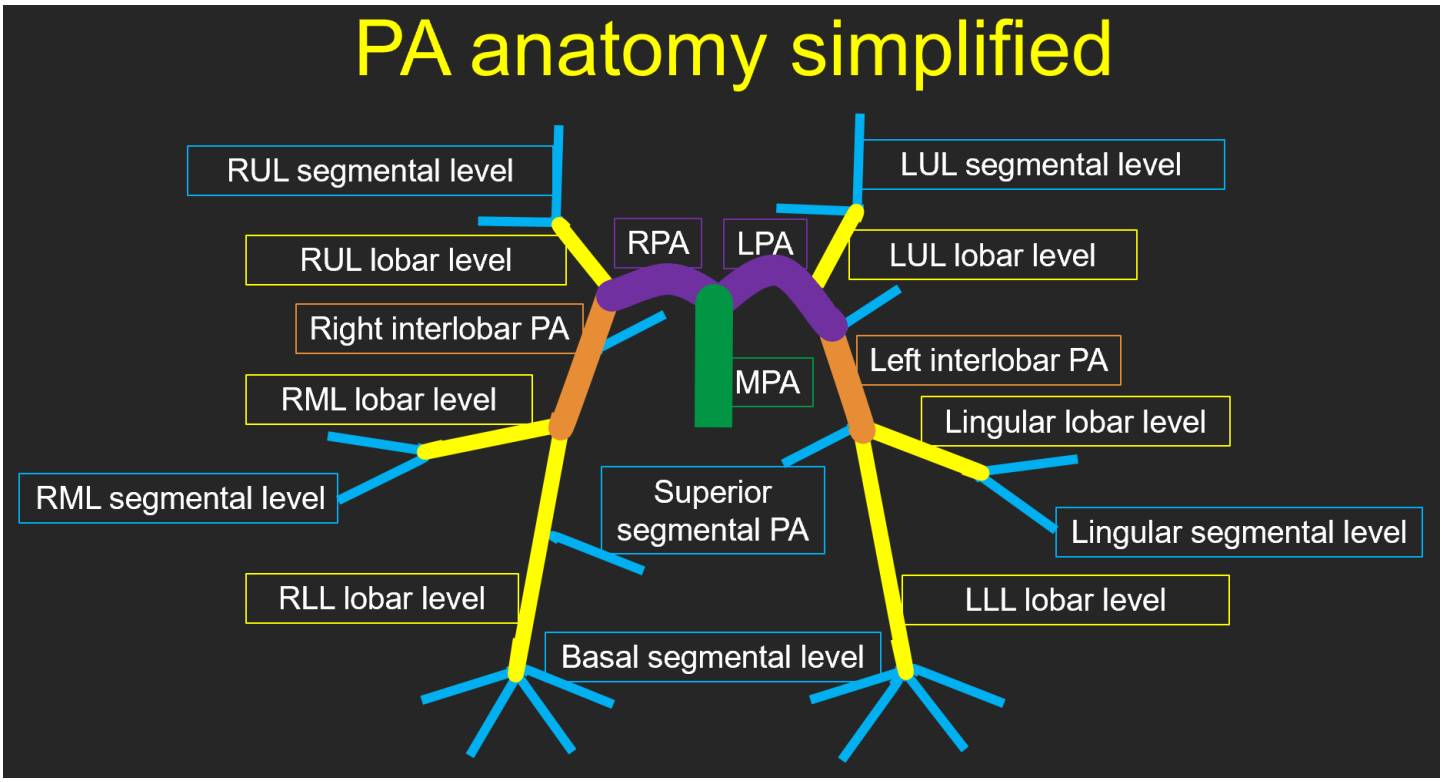
Penn Medicine

How to Read a CT Pulmonary Embolism Exam

1. Assess Quality of exam

a. Accurately identify the PA levels, particularly the segmental level.

- Segmental level: Segmental PAs parallel the segmental bronchial anatomy in general. Simplified to consider 10 segmental PAs in each lung: upper lobes 3 each, RML/lingula 2 each, lower lobes including superior segment 5 each. *Additionally consider:*
  - *Distal segmental: If dominant vessel beyond branch point of segmental PA.*
  - *Accessory segmental: If small vessel arising off a central PA.*
- Subsegmental level: Beyond branch point of segmental level.



Different levels in different colors: Main PA is green, right and left PA are purple, interlobar PAs are orange, lobar level is yellow, segmental level is blue, while subsegmental level is not pictured here.

Adjust window Width/Level to 700/100 or by using double-half method (example, if ROI on main PA is 500 HU, set Width/Level near to 1000/250).

b. Identify the limitations/artifacts.

- *More common:* Suboptimal contrast opacification, Pulmonary motion artifact, Streak artifact from dense contrast in the SVC, Flow-related artifact, Image noise.
- *Less common:* Transient interruption of contrast due to IVC inflow, Streak artifact from arm lying alongside chest, Parenchymal disease resulting in focal slow blood flow.

c. Determine which pulmonary artery level you can clearly see to.

Image Quality	Can clearly see to which level of PAs	Tips	ROI on main PA / Artifact
High	Proximal Subsegmental	- Allow for typical artifact	Often > 300 HU or 200–300 HU with no/minimal artifact
Moderate	Segmental	- Cannot clearly see proximal subsegmental level - Some segmental PAs may be limited by typical artifact	100–200 HU or 200–300 HU may be seen in both moderate and low quality depending on extent of artifact
Low	Lobar	- Can see central PAs to lobar level - Cannot clearly see segmental or subsegmental level	
Nondiagnostic	Main, Right, Left, Interlobar or None	- Cannot clearly see lobar level - Ideally rescan with optimized technique	< 100 HU

- Need contrast > 100 HU in a vessel to evaluate it.
- For Nondiagnostic exam or equivocal finding *(except possible isolated SSPE)* — rare < 2% of scans — ideally call the technologist to rescan the patient with additional IV contrast and optimized technique; note if eGFR < 30 which is uncommon, discuss with requesting physician first.
    - Optimized technique checklist: Default for any rescan.

Optimized Technique Checklist

- *Suboptimal contrast opacification:*
  - ✓ Look at monitoring phase of initial scan to ensure ROI was placed correctly
  - ✓ Better IV access
  - ✓ ↑ contrast rate
  - ✓ ↓ kVp
  - ❑ Consider Dual-energy technique *if available*
- *Transient interruption of contrast (TIC) or Pulmonary motion:*
  - ✓ Breath-hold coaching. Consider expiration for TIC
- *Image noise:*
  - ❑ Consider large PE protocol *if* large body habitus
- *Streak artifact from SVC if main limitation:*
  - ❑ ↓contrast rate and volume *particularly if* low kVp

    - Delayed PE technique: Less common, use for these limitations — *Flow-related artifact, Low cardiac output, Parenchymal disease, Bronchial artery inflow artifact.*

2. Determine if there is a PE

Acute vs. Chronic PE:

- Acute PE features: Often located in center of vessel. If eccentric, it makes acute angles with vessel wall. If completely occlusive, the artery may be expanded by filling defect.
- Chronic PE features: Eccentric, makes obtuse angles with vessel wall, web-like, recanalization. If completely occlusive, the artery is often contracted.

Distinguishing Artifacts/Mimics from PE:

- Artifacts are indicated by filling defects with ill-defined margins or oblique/perpendicular orientation to long axis of vessel. Whereas, acute PE should have well-defined margins and be longitudinally oriented to vessel.
- If filling defect has ROI > 125 HU on standard CT PE exams, it is typically artifact, NOT acute PE. However, if ROI less than that, it may be PE or artifact. For small filling defects, zoom in and ensure that ROI is ½ diameter of filling defect and well within it, otherwise measurement may not be reliable.
- Artifacts may be explained by exam limitations affecting that region.
- Filling defect in a pulmonary vein or mucoid impacted bronchus can mimic acute PE. Perivascular tissue or lymph node at hilar and central branch points can mimic chronic PE. Whereas, discrete filling defect within pulmonary arteries across branch point supports PE, but watch out for bronchial artery inflow artifact which may also appear this way.

Sample Impression: Acute bilateral pulmonary emboli with a moderate clot burden most proximally involving the right interlobar pulmonary artery and left lower lobar level. No right ventricular strain. RV/LV ratio is < 1, normal.

- Clot burden for acute PE: Estimate of total percentage obstruction of overall pulmonary arterial circulation: small < 20%, moderate 20%–40%, large > 40%.

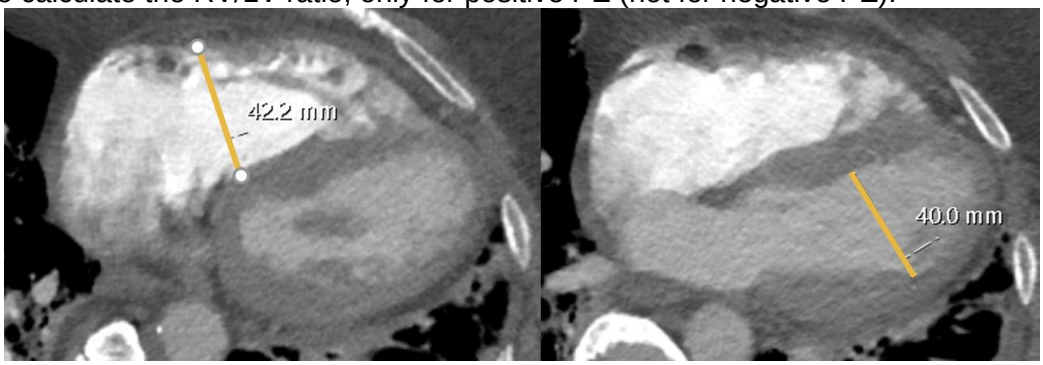
Isolated Subsegmental PE (SSPE)**:**

- Only one PE and it is in a subsegmental level.
- Double-check that it is not artifact. If more likely artifact, do not call. If equivocal, specify “low confidence”.
- *Sample Impression:* Acute isolated subsegmental pulmonary embolism of uncertain clinical significance. If the decision for anticoagulation is uncertain, consider a lower extremity venous ultrasound.

3. Evaluate for Ancillary findings

Sign of right ventricular strain (RV/LV ≥ 1)
Dilated main PA (> 3.1 cm) which may reflect elevated pulmonary arterial pressure
Right heart clot
Pulmonary infarct

It is important to calculate the RV/LV ratio, only for positive PE (not for negative PE):



- Measure RV and LV on same or different axial levels at the respective valve planes, at widest diameter, from free wall endocardium to interventricular septum avoiding membranous septum, inner wall to inner wall allowing for trabeculations, staying perpendicular to septum.
- Normal < 1, report as “normal” without specifying the actual number.
- Sign of RV strain ≥ 1, report the actual number rounded to one decimal.

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