**Adequate Contrast Enhancement of CT Pulmonary Angiograms**

**Descriptor:**

Assessment of the contrast enhancement in CT pulmonary angiograms to ensure adequacy for diagnosis.

**Background:**

Suboptimal enhancement of CT pulmonary angiograms leads to non diagnostic studies and therefore unnecessary exposure to contrast and radiation, in addition to putting patient safety at risk by delaying diagnosis.

## The Cycle

**The standard:**

Current evidence suggests that a level of 210 Hounsfield Units (HU) is required in a pulmonary vessel to distinguish chronic thrombus from an enhancing vessel [1]. Acute thrombus has lower HU than chronic and therefore the level of vascular enhancement can be lower but still distinguishable from the thrombus. Given that contrast enhancement is often lower in more peripheral vessels, a level of 210 HU in the main pulmonary artery was defined as the level for acceptable enhancement.

**Target:**

The literature to date suggests that approximately 10.8% of CTPAs may be suboptimal based on all causes, including poor contrast enhancement and motion artefact amongst other factors [2]. Therefore, the target has been defined as no more than 11% of CTPAs having HU <210 in the main pulmonary artery.

## Assess local practice

**Indicators:**

A circular region of interest should be measured in the largest axial image of the main pulmonary artery with a diameter of approximately 50% of the vessel.

**Data items to be collected:**

The details of the scan and the average HU for each patient should be recorded in a database. The percentage of scans below the threshold of 210 HU can then be calculated.

**Suggested number:**

A minimum of 50 consecutive CTPAs per protocol should be assessed. These can be identified through RIS or logbooks.

(Ideally this should be performed prospectively and radiographers and radiologists encouraged to document in RIS when the protocol has not been followed)

**Suggestions for change if target not met:**

- Ensure radiographers realise the importance of a large cannula (ideal minimum of 20 gauge) in the antecubital fossa with appropriate arm positioning not too high above the head. The preferred rate of contrast injection should be established

- With faster scanners and appropriate patients, scanning in minimal rather than maximal inspiration can be encouraged (to avoid a negative intrathoracic pressure drawing unopacified blood in from the IVC)

- The strength and volume of contrast can be adjusted and the use of a saline chaser explored

Utilise a different protocol:

• Fixed timing eg. 17s

• Bolus tracking, generally performed from the main pulmonary artery, but different thresholds may be used and the time to first scan slice can be varied

• A test bolus can be used to define the optimum timing using a preliminary bolus to define the peak enhancement and follow it with the diagnostic scan

**Resources:**

- Access to RIS, PACS and a database

- Staff time per audit: 4-8 hours

**References:**

1. Wittram C, Maher MM, Halpern E, Shepard JO. Hounsfield unit values of acute and chronic pulmonary emboli. Radiology 2005: 235; 1050-1054.
2. Jones SE, Wittram C. The indeterminate CT pulmonary angiogram: imaging characteristics and patient clinical outcome. Radiology 2005; 237: 329-337.
3. Yilmaz Ö, Üstün ED, Kayan M, et al. Diagnostic quality of CT pulmonary angiography in pulmonary thromboembolism: A comparison of three different kV values. Medical Science Monitor : International Medical Journal of Experimental and Clinical Research. 2013;19:908-915. doi:10.12659/MSM.889578.

**Editor's comments:**

The time interval to re-audit will depend on the scanner throughput, but a minimal of 30 additional scans from the implementation of a new protocol is advised.

Regardless of protocol, the diagnostic quality of CTPAs is often compromised by the acute setting (where it may be difficult to insert the optimal size cannula for example).  Pulmonary vascular opacification is also highly dependent on the patient’s BMI, which again cannot be easily controlled for in the acute setting.  As such, I believe that a total of 50 cases (rather than 30) will be required.  References will also need updating at the next review

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