CTA Pulmonary Embolism
CTA Chest (pulmonary angiogram)

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In accordance with the ALARA principle, TRA policies and protocols promote the utilization of radiation dose reduction techniques for all CT examinations. For scanner/protocol combinations that allow for the use of automated exposure control and/or iterative reconstruction algorithms while maintaining diagnostic image quality, those techniques can be employed when appropriate. For examinations that require manual or fixed mA/kV settings as a result of individual patient or scanner/protocol specific factors, technologists are empowered and encouraged to adjust mA, kV or other scan parameters based on patient size (including such variables as height, weight, body mass index and/or lateral width) with the goals of reducing radiation dose and maintaining diagnostic image quality.

If any patient at a TRA-MINW outpatient facility requires CT re-imaging, obtain radiologist advice prior to proceeding with the exam.

The following document is an updated CT protocol for all of the sites at which TRA-MINW is responsible for the administration, quality, and interpretation of CT examinations.

Include for ALL exams
- **Scout**: Send all scouts for all cases
- **Reformats**: Made from thinnest source acquisition
  - **Scroll Display**
    - Axial recons - Cranial to caudal
    - Coronal recons - Anterior to posterior
    - Sagittal recons - Right to left
  - Chest reformat should be in separate series from Abdomen/Pelvis reformat, where applicable
- **kVp**
  - 100 @ <=140lbs
  - 120 @ >140lbs
- **mAs**
  - Prefer: Quality reference mAs for specific exam, scanner and patient size
  - Auto mAs, as necessary
- **For CTAs**: send source data (0.625 mm thick or equivalent) to PACS and TeraRecon

**OTHER:**
- Please call radiologist for OUTPATIENT rule out PE before patient leaves department
  - Mark these studies STAT
Indication: Evaluate for pulmonary embolism (chest pain, shortness of breath, elevated D-dimer, etc.)

Patient Position: Supine, feet down with arms above head

Scan Range (CC z-axis): Lung apices to L1 (scan cranial to caudal)
**Remember, please isocenter the exam using the lateral scout**

Prep: No solids (liquids OK) for 3 hours prior to examination
- Note: Okay to continue examination if prep is incomplete or not done

Oral Contrast: None

IV Contrast Dose, Flush, Rate and Delay:
- Dose & Rate: (modify volume if using something other than Isovue 370; 20-gauge or larger IV, at least 4 inches above wrist or pressure injectable line)
  - < 200 lbs 80 mL Isovue 370, 4cc/sec
  - > 200 lbs 100 mL Isovue 370, 5cc/sec
- Flush: 50 mL saline
- Delay: Bolus trigger in Main Pulmonary Artery (threshold 100HU)
Acquisitions: 1 (post-contrast) \textit{scan cranial to caudal}

- **Pulmonary arterial phase chest** - BOLUS TRACK with HU trigger of 100 ROI placed in main pulmonary artery + 5 second delay
  - Only if bolus tracking is not available, use fixed scan delay:
    - 16 slice: 15 sec
    - 64 slice: 20 sec
  - **NOTE:** If acquisition is questionable, call radiologist to determine need to re-bolus/re-scan
- **Single breath, full inspiration preferred;** mid-expiration should be considered ONLY if inspiratory images are non-diagnostic
  - Expiratory imaging significantly limits evaluation of the lung parenchyma
  - Mid-expiration instructions: “Take a deep breath in, let half of the air out, stop breathing”
Series + Reformats:

1. Pulmonary arterial phase chest
   a. Axial 2-2.5 mm ST kernel
   b. Axial 1.2-1.5 mm lung kernel
   c. Axial 10 x 2 mm MIP ST kernel
   d. Coronal 2 mm ST kernel
   e. Sagittal 2 mm ST kernel
   f. Oblique 10 x 2 MIP RIGHT Pulmonary Artery ST kernel – angulation of obliques should be optimized for each patient's anatomy to best demonstrate pulmonary arteries
   g. Oblique 10 x 2 MIP LEFT Pulmonary Artery ST kernel – angulation of obliques should be optimized for each patient's anatomy to best demonstrate pulmonary arteries
   h. Axial 1.25 x 1 mm ST kernel (SuperD where doable)

***Machine specific protocols are included below for reference

Machine specific recons (axial ranges given above for machine variability):

*Soft tissue (ST) Kernel, machine-specific thickness (axial):
  • GE = 2.5 mm
  • Siemens = 2 mm
  • Toshiba = 2 mm

*Lung Kernel, machine-specific thickness (axial):
  • GE = 1.25 mm
  • Siemens = 1.2 mm (or 1.5 mm on older generation)
  • Toshiba = 1 mm

Source: http://pubs.rsna.org/doi/pdf/10.1148/radiol.10090908
General Comments

NOTE:
Use of IV contrast is preferred for most indications *aside from*: pulmonary nodule follow-up, HRCT, lung cancer screening, and in patients with a contraindication to iodinated contrast (see below).

**Contrast Relative Contraindications**
- **Severe contrast allergy**: anaphylaxis, laryngospasm, severe bronchospasm
  - If there is history of severe contrast allergy to IV contrast, avoid administration of oral contrast
- **Acute kidney injury (AKI)**: Creatinine increase of greater than 30% over baseline
  - Reference hospital protocol (creatinine cut-off may vary)
- **Chronic kidney disease (CKD) stage 4 or 5** *(eGFR < 30 mL/min per 1.73 m²) NOT on dialysis*
  - Reference hospital protocol

**Contrast Allergy Protocol**
- Per hospital protocol
- Discuss with radiologist as necessary

**Hydration Protocol**
- For eGFR 30-45 mL/min per 1.73 m²: Follow approved hydration protocol

**IV Contrast (where indicated)**
- Isovue 370 is the default intravenous contrast agent
  - See specific protocols for contrast volume and injection rate
- If Isovue 370 is unavailable:
  - Osmolality 350-370 (i.e., Omnipaque 250): Use same volume as Isovue 370
  - Osmolality 380-320 (i.e., Isovue 300, Visipaque): Use indicated volume + 25 mL *(not to exceed 125 mL total contrast)*

**Oral Contrast**
- Dilutions to be performed per site/hospital policy (unless otherwise listed)
- Volumes to be given per site/hospital policy (unless otherwise listed)
- TRA-MINW document is available for reference if necessary (see website)

**Brief Summary**
- **Chest only**
  - Chest W, Chest WO
  - CTPE
  - HRCT
  - Low Dose Screening/Nodule
  - None
• **Pelvis only**
  - Pelvis W, Pelvis WO
    - Water, full instructions as indicated

• **Routine, excluding chest only and pelvis only**
  - Abd W, Abd WO
  - Abd/Pel W, Abd/Pel WO
  - Chest/Abd W, Chest/Abd WO
  - Chest/Abd/Pel W, Chest/Abd/Pel WO
  - Neck/Chest/Abd/Pel W, Neck/Chest Abd Pel WO
  - CTPE + Abd/Pel W
    - TRA-MINW offices: Dilute Isovue-370
    - Hospital sites:
      - ED: Water, if possible
      - Inpatient: prefer Dilute Isovue 370
        - Gastrografin OK if Isovue unavailable
        - Avoid Barium (Readi-Cat)
      - FHS/MHS Outpatient: Gastrografin and/or Barium (Readi-Cat)

• **Multiphase abdomen/pelvis**
  - Liver, pancreas
    - Water, full instructions as indicated
  - Renal, adrenal
    - None

• **CTA abdomen/pelvis**
  - Mesenteric ischemia, acute GI bleed, endograft
    - Water, full instructions as indicated

• **Enterography**
  - Breeza, full instructions as indicated

• **Esophogram**
  - Dilute Isovue 370, full instructions as indicated

• **Cystogram, Urogram**
  - None

• **Venogram**
  - Water, full instructions as indicated