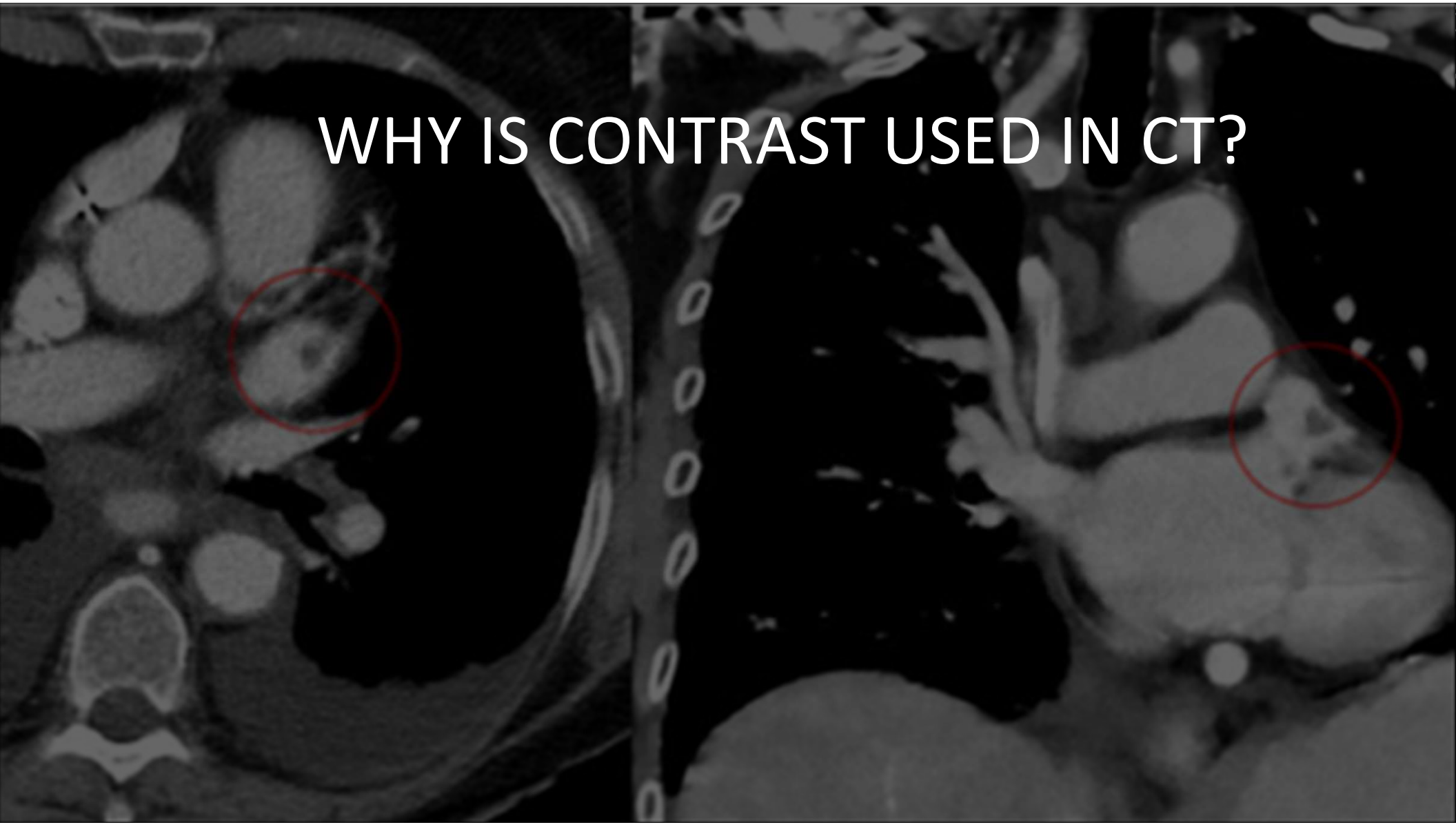
CONTRAST BASICS FOR PROTOCOL OPTIMIZATION

Carrie Bartels RT(R) CT
Senior CT Technologist
CT Protocol Team
UW Health - Radiology
600 Highland Avenue
Madison, WI 53792
608-890-5458
cbartels2@uwhealth.org

OBJECTIVES

- Overview of why Contrast is used in CT
- Contrast administration access
- Types of Exams that use contrast and purpose
- Factors Affecting Contrast Enhancement and Scan Timing

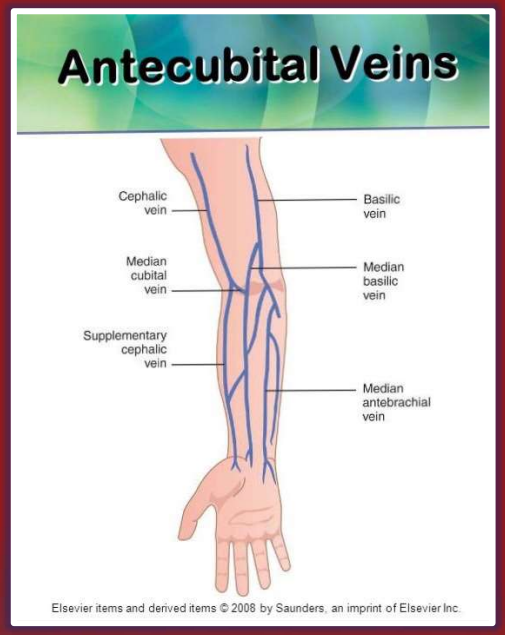
WHY IS CONTRAST USED IN CT?

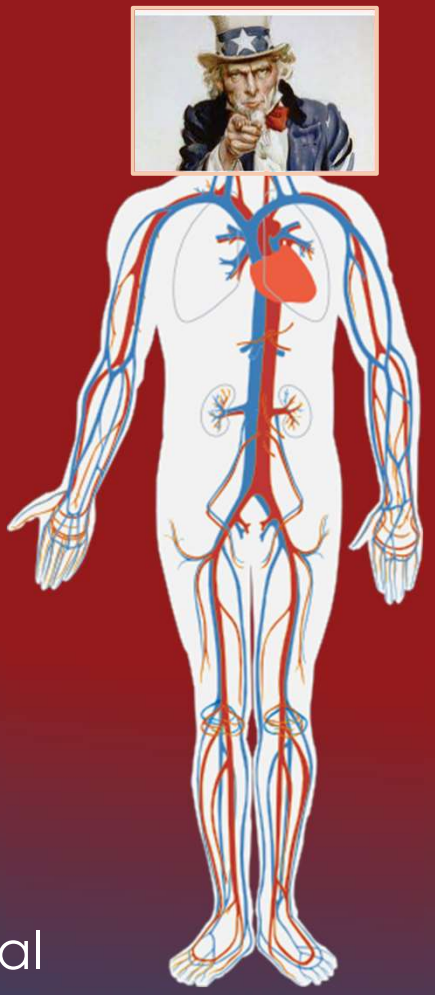


CONTRAST ADMINISTRATION ACCESS

CIRCULATORY SYSTEM

SAM QUESTION





1. Inject via antecubital vein

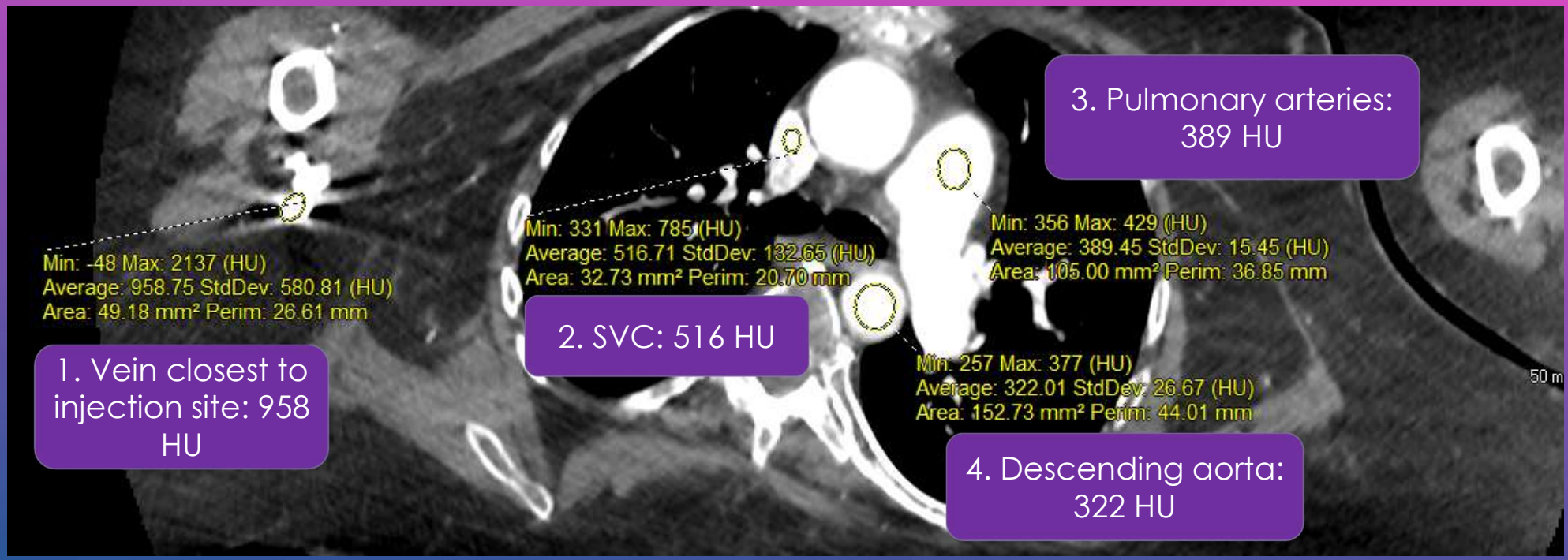
2. Blood goes into SVC and then into right atrium

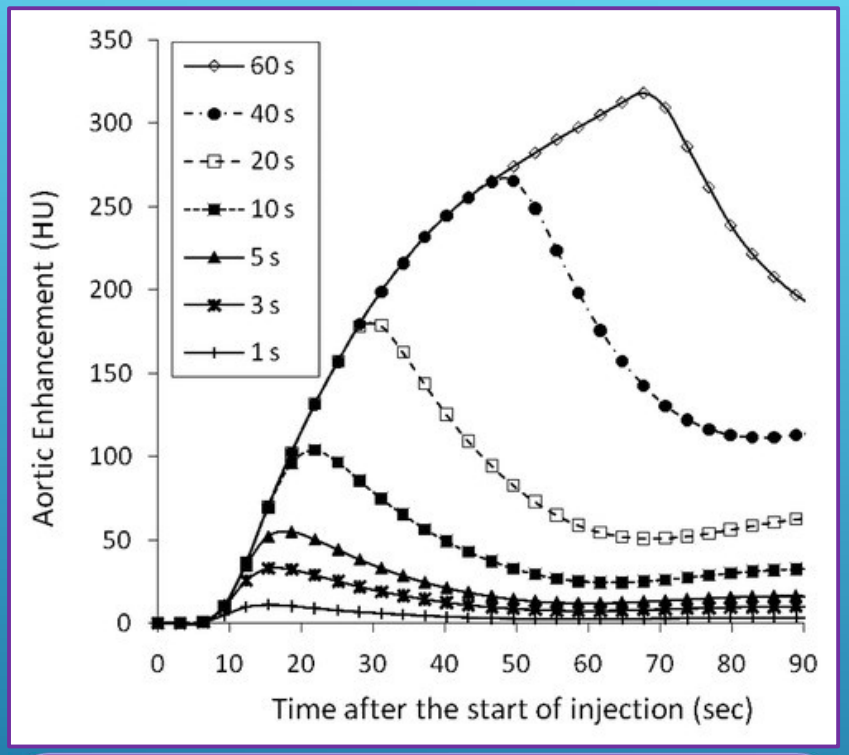
3. Blood goes to right ventricle and goes out pulmonary artery to lungs

4. Returns via pulmonary vein and goes to left atrium, to the left ventricle then the aorta.

5. First stop is supplying blood to the heart via coronaries. Then head via carotid and vertebral vessels.

Numbers decrease with ROI locations via path blood follows from injection site → as blood/Iodine mix, HU goes down as we move from injection site because of blood mixing diluting agent.

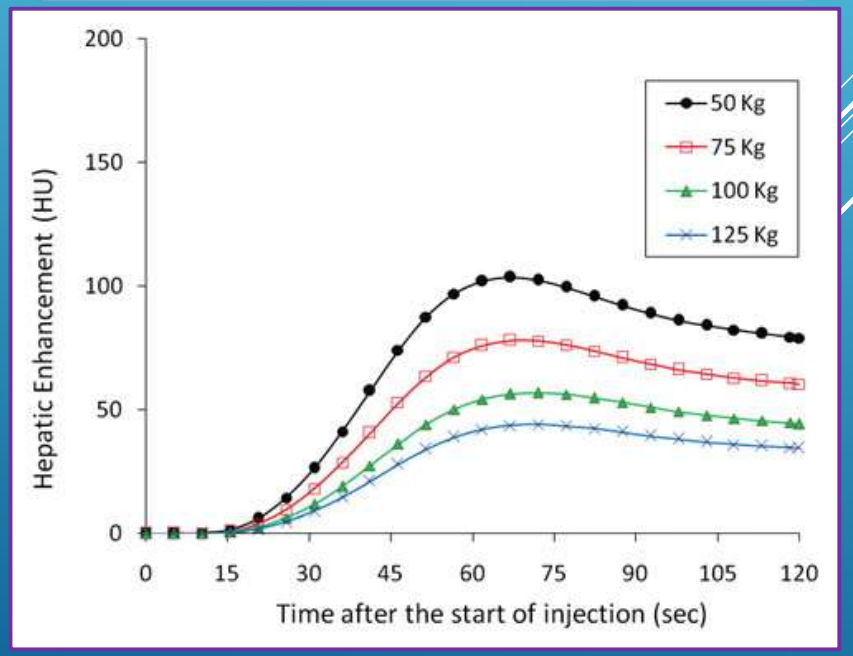




Arterial enhancement is "in and out" faster relative to parenchymal

Longer and longer injections push CT enhancement up and delay peak enhancement

Bigger people have more blood… which dilutes contrast agent



Reference Bae, K. T., J. P. Heiken, and J. A. Brink. (1998). "Aortic and hepatic contrast medium enhancement at CT. part i. prediction with a computer model." *Radiology* 207(3):647–55.

Average peak enhancement times

Arterial ~ 15 seconds

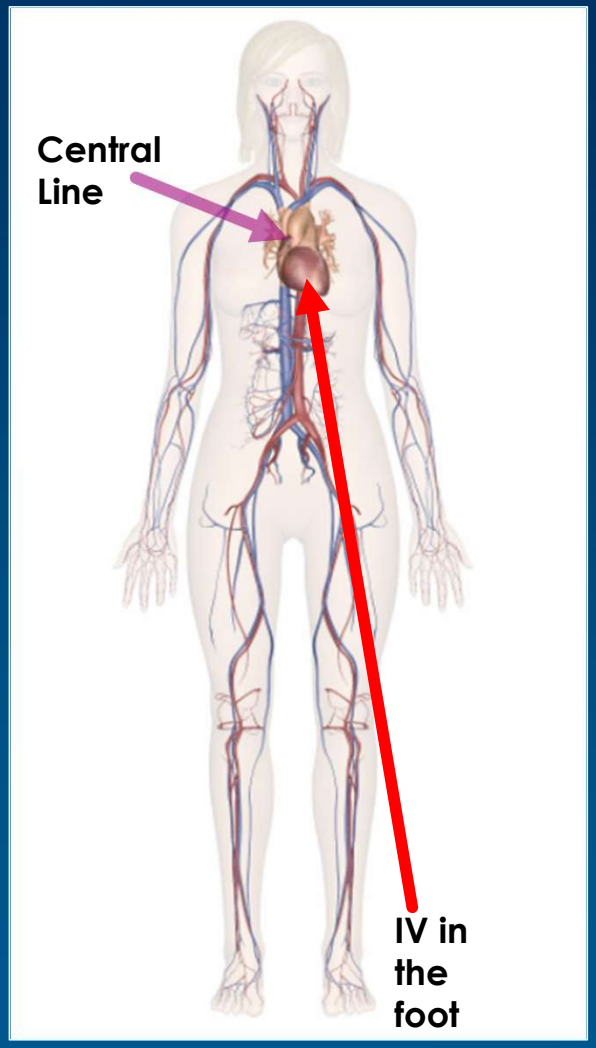
Hepatic ~ 40 seconds

Portal Venous ~ 70 seconds

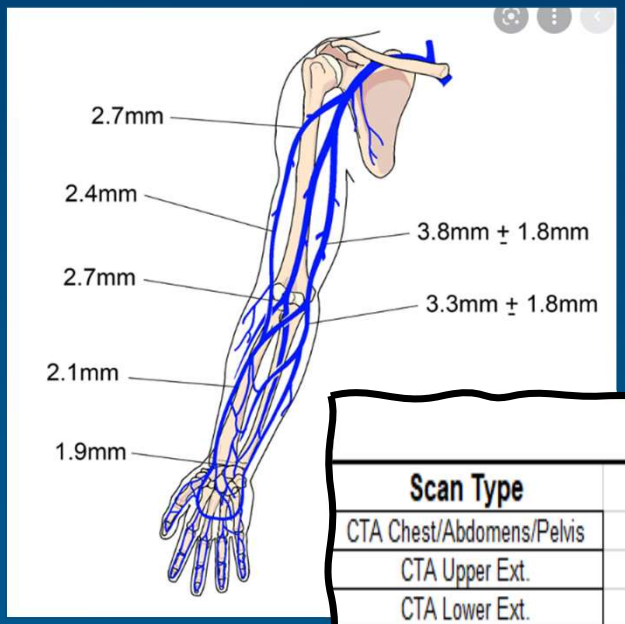
Contrast time of arrival will vary from person to person, but assuming an antecubital injection, values will generally be in the range of 7 to 10 seconds for the pulmonary artery, 12 to 15 seconds for the ascending aorta, 15 to 18 seconds for the abdominal aorta, and 30 to 40 seconds for hepatic parenchyma.

Reference:

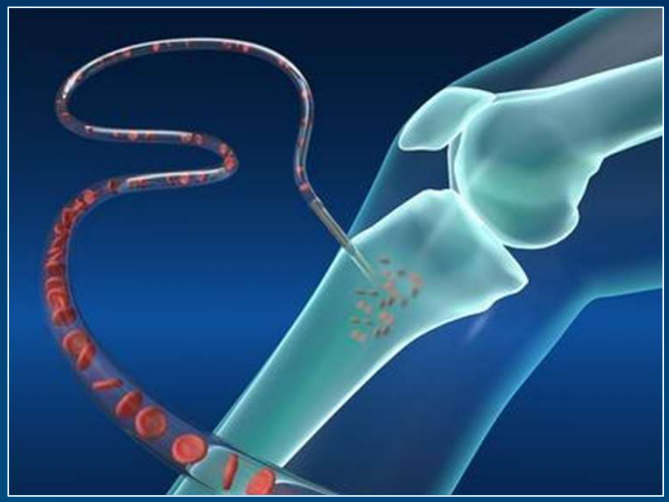
"The CT Handbook: Optimizing Protocols for Today's feature-rich scanners" By Tim Szczykutowicz. Medical Physics Publishing 2020



PIV (Peripheral Intravenous Line)

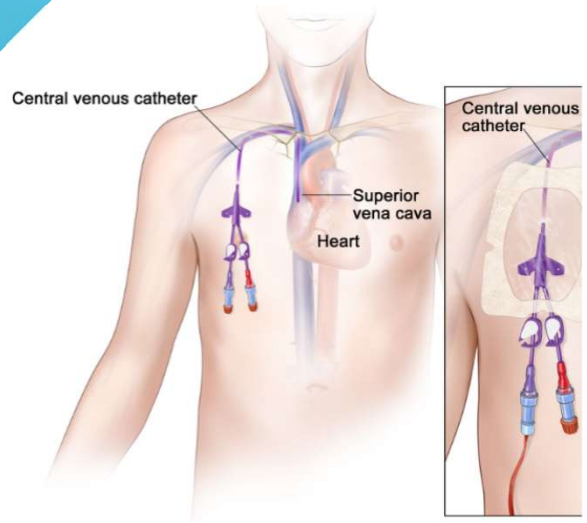


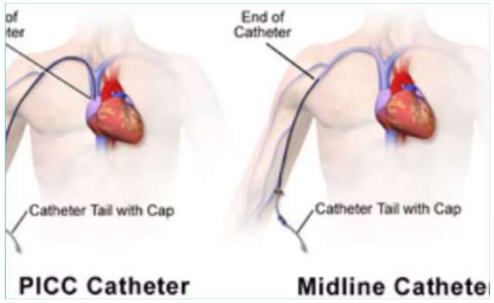
IO (intraosseous) for Trauma Patients

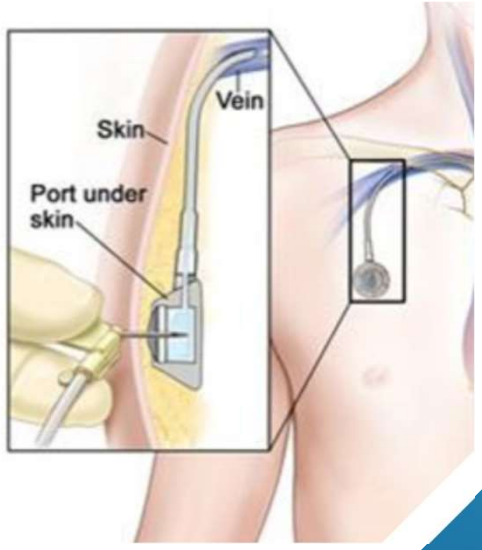


CT IV Requirements

Scan Type	IV gauge	Side Placement
CTA Chest/Abdomens/Pelvis	18	AC Either arm
CTA Upper Ext.	18	AC Unaffected side
CTA Lower Ext.	18	AC Either arm
CTA Gated Chest	18	AC Right arm
CTA Non-Gated Chest	18	AC Right arm







- PICC (Peripherally Inserted Central-Line Catheter)/Central Line
- Midline (inserted by RN or Radiology)
- Port- Regular vs Power

TYPES OF EXAMS THAT USE CONTRAST AND PURPOSE

Indication(s)	Protocol	Oral Contrast Type
RCC, NET (hypervascular mets)	Biphasic	Water
Cancers with possible hep met disease. (EXCEPTIONS: Not for lymphoma, testicular ca, RCC/NET, prostate ca, discuss in young pts)	High quality cancer follow up	Oral
Cirrhosis, HCC	R/o HCC	Water
Cirrhosis, eval for transplant	Liver Transplant recipient work up	Water
Possible liver donor	Liver donor workup	Water
Pre liver resection, post transplant	Consider triphasic liver	Water
Abdominal pain, Pancreatitis	Routine abdomen/pelvis	Oral
Assess for hernia	Hernia protocol	Oral
Assess for pancreas cancer, assess resectability. (But if known metastatic or unresectable pancreas cancer, see above, high quality cancer follow up)	Pancreas cancer	Water
Pancreas transplant	Consider CTA pancreas tx if requested	Water
Mesenteric ischemia	Mesenteric ischemia	Water
Active bleeding/active GI bleeding. Bleeding associated with transplant, donor, Pancreatitis, Hypervascular Metastasis, or HCC	Active Bleeder	None
Occult GI bleed (non-acute)	GI bleeding protocol	Breeza
Assess for hematoma (RP hematoma), no active bleed	Non con A/P	None
Crohn with acute pain/complication	Routine abdomen/pelvis, + oral	Oral

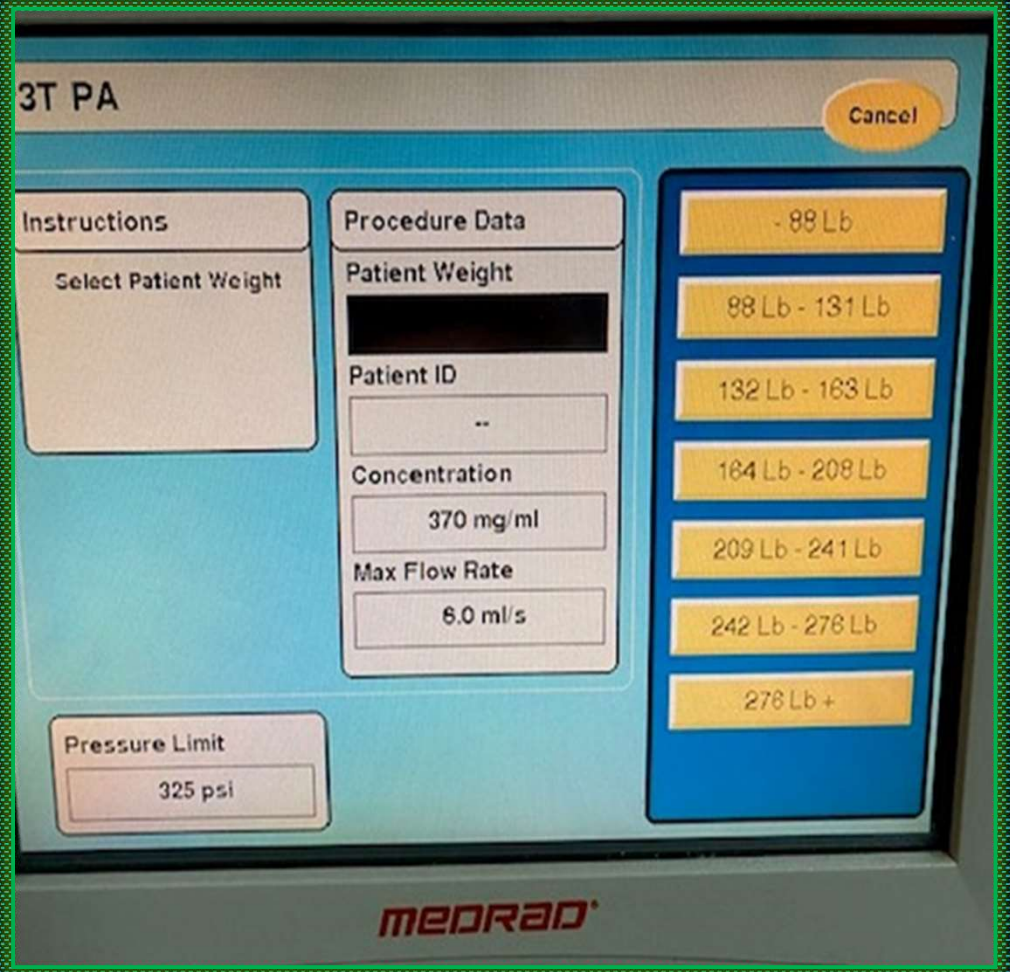
Neck/Chest/Abdomen/Pelvis

Scan Combination	Contrast Dosage	Injection Rate
C/A/P + Neck Combo		
C/A/P	**86 mL Iohexol 350 mgI/mL + 20 mL NaCl flush**	**3 mL/sec**
Neck	**64 mL Iohexol 350 mgI/mL + 20 mL NaCl flush**	**2 mL/sec**
Change the Prep Delay to 45 seconds (from 115 seconds) on the Neck protocol.		
Chest + Neck Combo		
Chest	**64 mL Iohexol 350 mgI/mL + 30 mL NaCl flush**	**3 mL/sec**
Neck	**64 mL Iohexol 350 mgI/mL + 30 mL NaCl flush**	**2 mL/sec**
Change the Prep Delay to 45 seconds (from 115 seconds) on the Neck protocol.		

- **It is important to scan the CT Neck as quickly as possible to take advantage of residual contrast from CAP bolus.**
  - You will have to End Exam, re-position, re-zero, and re-scout the patient. Select small, medium and large based on the table below.
  - The CT Neck Scan requires a separate contrast injection
  - Start the scan at the top of the orbits and scan to the carina. Remind the patient not to swallow during the scan.
  - **Please remember to change the prep group delay in the neck protocol to 45 seconds**

Factors Affecting Contrast Enhancement and Scan Timing


MEDRAD
Stellant


3T PA
Cancel
Instructions
Select Patient Weight
Procedure Data
Patient Weight
Patient ID
--
Concentration
370 mg/ml
Max Flow Rate
6.0 ml/s
Pressure Limit
325 psi
- 88 Lb
88 Lb - 131 Lb
132 Lb - 163 Lb
164 Lb - 208 Lb
209 Lb - 241 Lb
242 Lb - 276 Lb
276 Lb +
MEDRAD


KVO
Program name
Program
001 Routine Head <200 lbs
2 2 2
20 103 20
002 Routine Head 200-300 lbs
2 2 2
20 120 20
003 Routine Head >300 lbs
2 2 2
20 129 20
004 CTA H-N-P <200 lbs
5 4 4 5 5
40 85 50 42 30
005 CTA H-N-P 200-300 lbs
5.5 5 5 5.5 5.5
40 106 50 53 30
Ap
ulrich
medical

Weight-Based Contrast Instructions

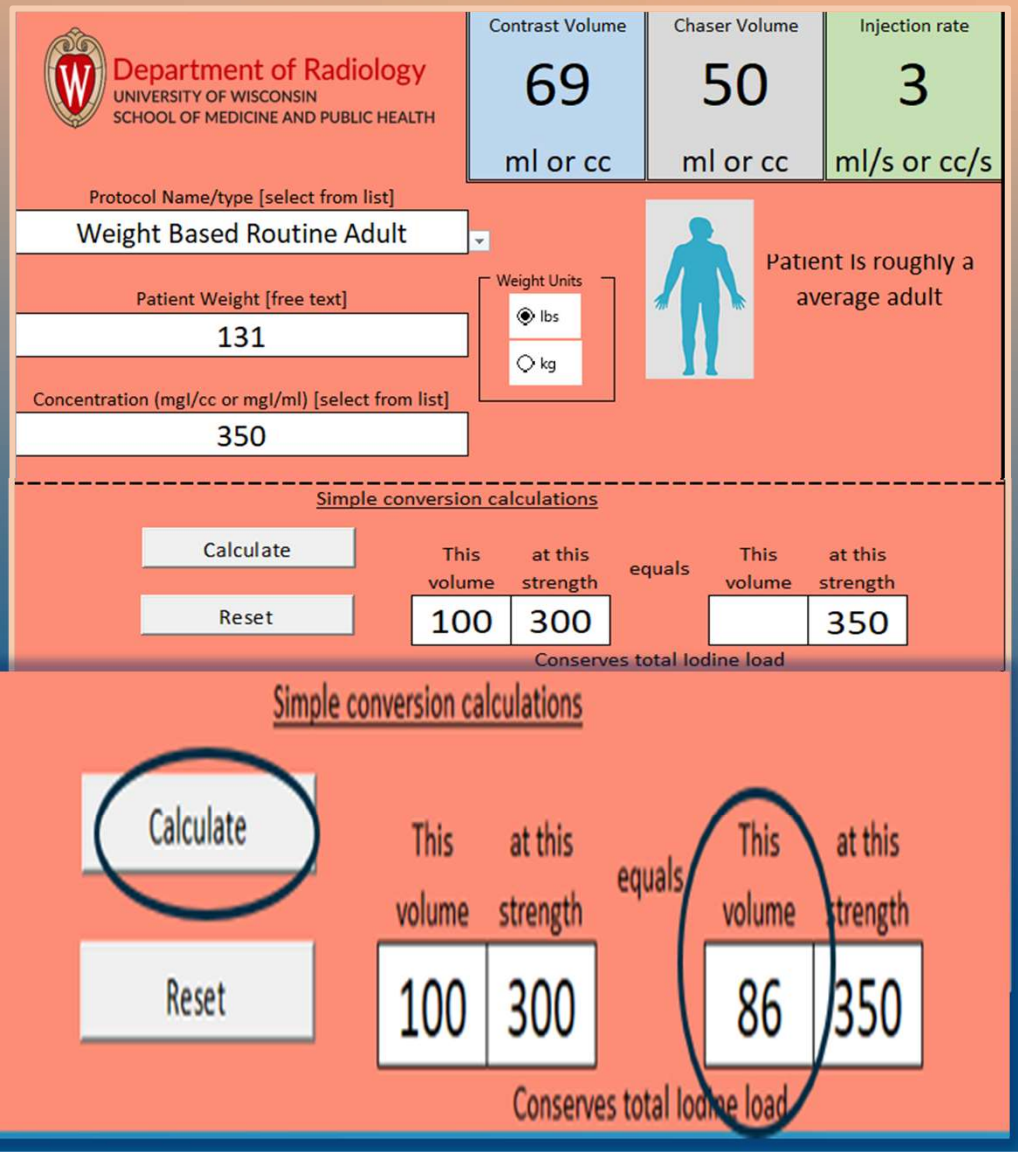
To convert between pounds (lbs), kilograms (kg), and or stones (st) see the weight conversion table.

All injections should be followed by a 50 mL saline flush. See the "IV Contrast Parameters" section of each protocol for more details.

Contrast volume for users without the Medrad P3T Option

This table uses an injection rate of 3 mL/sec

Patient Weight (lbs)	Contrast Volume (mL) (300 mg/mL concentration)	Contrast Volume (mL) (350 mg/mL concentration)	Saline Volume (mL)
130 and less	80 (minimum amount to load)	69 (minimum amount to load)	50
140	86	74	50
150	92	79	50
160	98	84	50
165	101	87	50
170	104	89	50
175	107	92	50
180	110	94	50
190	116	99	50
200	122	105	50
210	129	111	50
220	135	116	50
230	141	121	50
240	147	126	50
250 and larger	150 (max amount to load)	129 (max amount to load)	50



https://uwgect.wiscweb.wisc.edu/

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Contrast Volume	Chaser Volume	Injection rate
131 ml or cc	50 ml or cc	3 ml/s or cc/s

Protocol Name/type [select from list]: Weight Based Routine Adult

Patient Weight [free text]: 250

Weight Units: (•) lbs ( ) kg

Concentration (mgI/cc or mgI/ml) [select from list]: 350

Patient Is roughly a very obese adult

Patient weight = 250lbs

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Contrast Volume	Chaser Volume	Injection rate
69 ml or cc	50 ml or cc	3 ml/s or cc/s

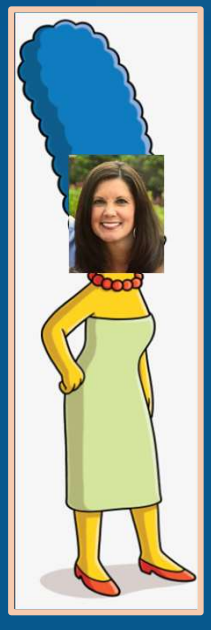
Protocol Name/type [select from list]: Weight Based Routine Adult

Patient Weight [free text]: 120

Weight Units: (•) lbs ( ) kg

Concentration (mgI/cc or mgI/ml) [select from list]: 350

Patient Is roughly a average adult



Patient weight = 120lbs

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PREVIOUS

Reviews and Commentary
State of the Art

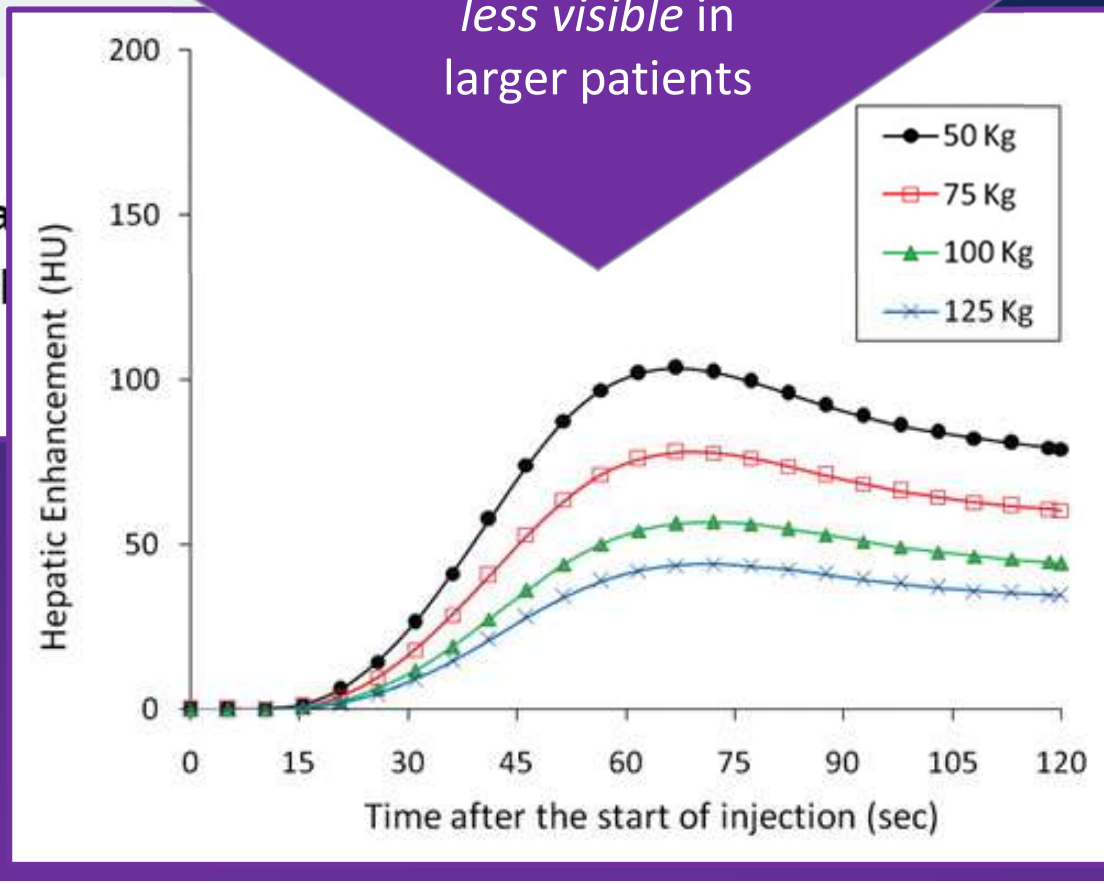
Intravenous Contrast Medium Administra
Scan Timing at CT: Considerations and Ap

Kyongtae T. Bae

Author Affiliations

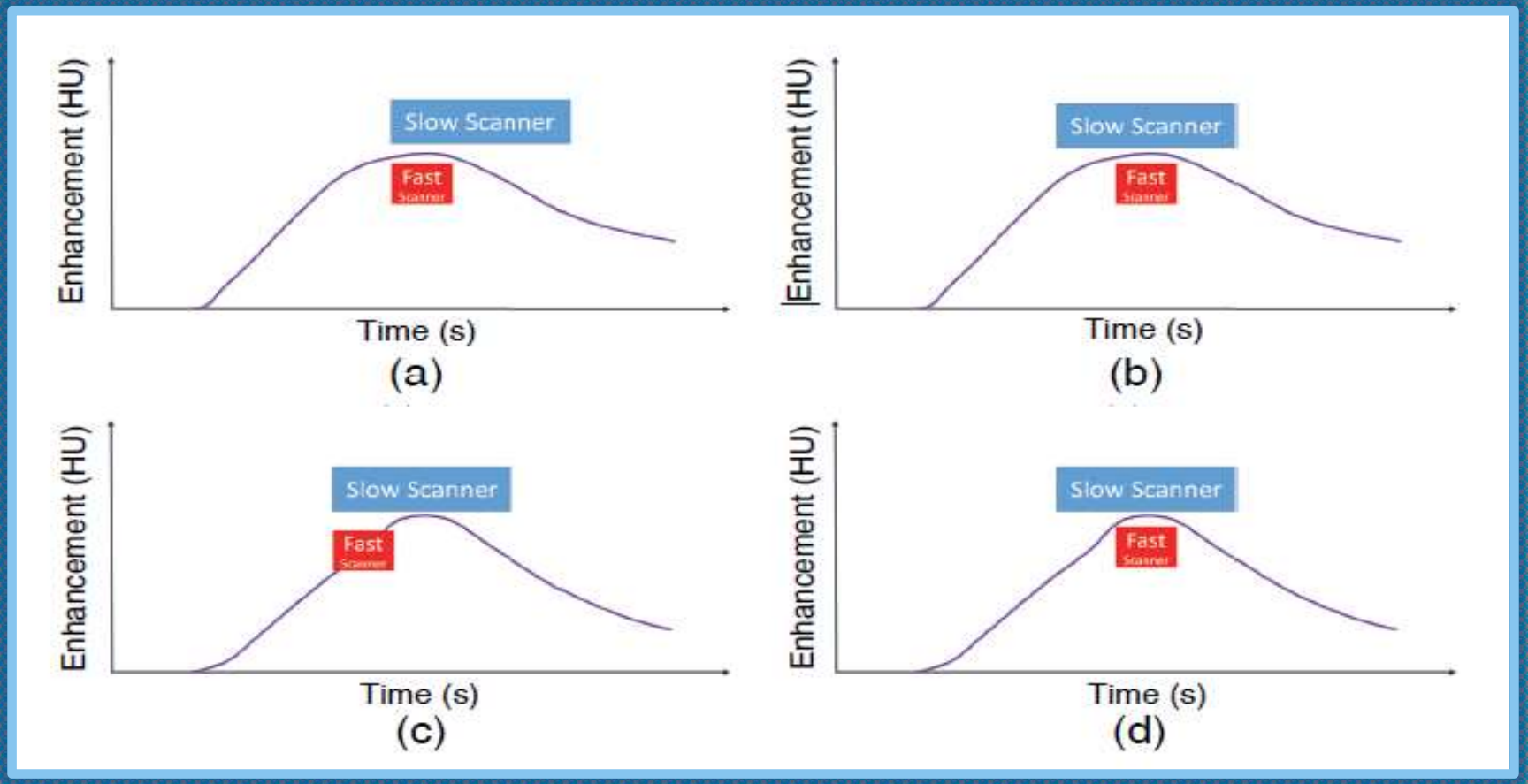
SAM Question

If every ones gets 125 mLs… contrast enhancement is *less visible* in larger patients




20 seconds
12 seconds

$$\textit{Scan delay} = \textit{Time to optimal enhancement} - \tfrac{1}{2}\,\textit{Scan duration}$$



"The CT Handbook: Optimizing Protocols for Today's feature-rich scanners" By Tim Szczykutowicz. Medical Physics Publishing 2020

> JAMA. 2022 Jun 9;e229879. doi: 10.1001/jama.2022.9879. Online ahead of print.

Comparison of Strategies to Conserve Iodinated Intravascular Contrast Media for Computed Tomography During a Shortage

Matthew S Davenport [1], Philip Chu [2], Timothy P Szczykutowicz [3], Rebecca Smith-Bindman [2]

Affiliations + expand

PMID: 35679081 PMCID: PMC9185519 DOI: 10.1001/

Free PMC article

Abstract

This study models the amount of contrast that could be
examinations in the context of the current a global shor

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Adult Protocol Table of Contents

- UW CT Protocols
- UWMF (1 S. Park/WIMR) CT Protocols
- 3D Lab TOC
- Turbo Button Instructions
- UWHC Miscellaneous Instructions
- Archive of Bi-Weekly Updates
- Protocol Design Philosophy
- Protocolling Assistance Document

Link to Table of Contents for Pediatric Protocols

Contrast Crisis 2022

Contents [hide]

http://r-faraday/mediawiki/index.php/Contrast_Crisis_2022

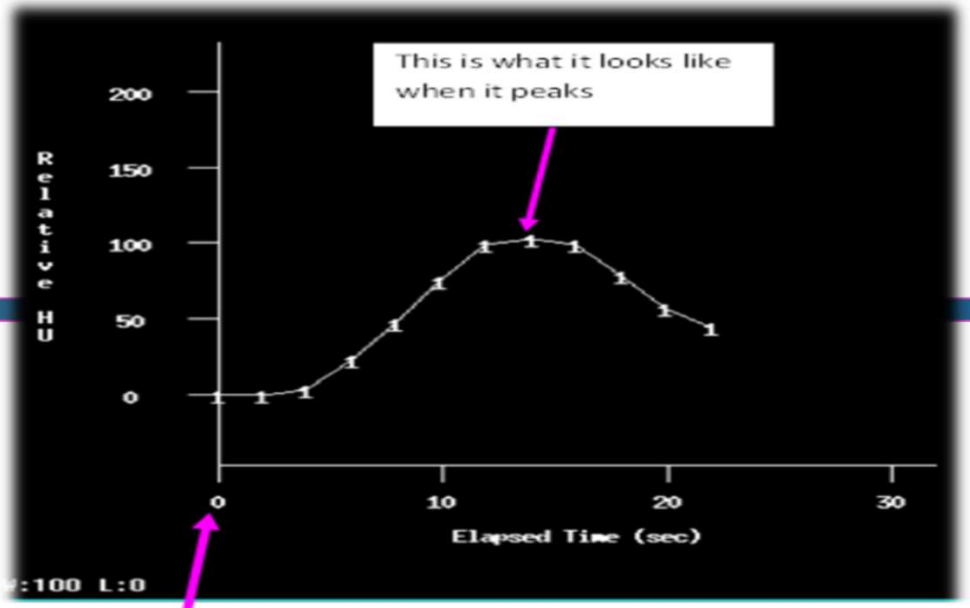
CTA CORONARY - Bolus Tracking vs Timing Bolus

- **Series 3** – CTA Coverage: Same as non - contrast scan
  - Use cardiac breathing instructions
  - Please record a new HR before this scan phase (see picture below)
  - SmartPrep on the descending aorta at the level of the carina. **Dynamic transition is turned on so the scan will progress without the need for you to hit 'scan phase'.**


Scout

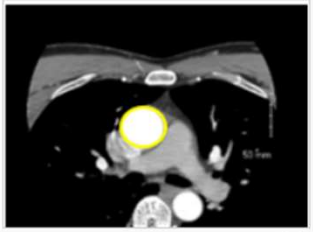

ROI Location


ROI Location



- **Series 3** – Timing Bolus - On the ascending aorta


Scout


Timing Bolus MROI Location

Start with 7 seconds (prep delay) and then add 2 sec for every number "1" until it peaks. The delay for this exam would be 21 seconds.

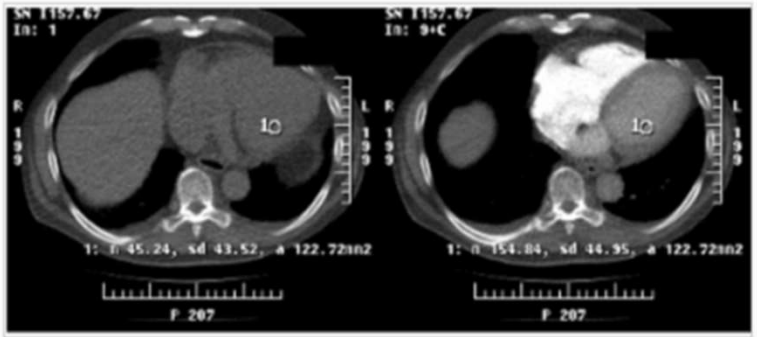
- Use 10 ml of Iodixanol and 50 ml of saline at 6 ml/sec
- Take 16sec + Bolus time = Prep delay
- 16 seconds includes the 12 seconds of breathing instructions PLUS a phantom 4 seconds. Add the 16 to your MROI peak and that is your Timing Bolus Time/ Prep Group Delay.
- If the timing for the Prep Group Delay is less that 20 seconds, please change the prep group to 20 seconds. We do not want to use anything less than 20 seconds for a delay.

Scout (REV 256)

ROI Location

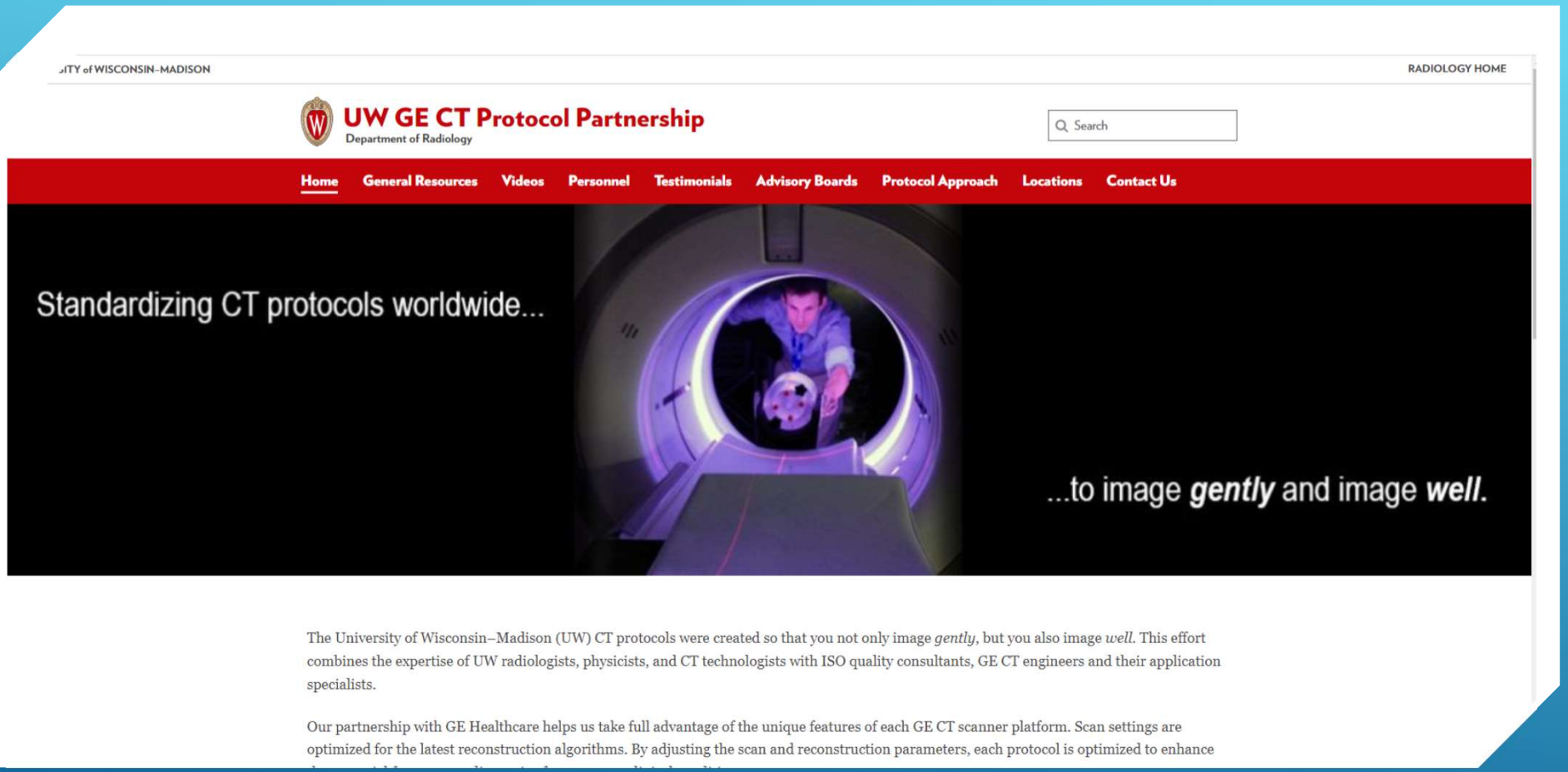
ROI Location

Scout (Non-REV 256)



ROI Location

Dynamic Transition



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