

CT Perfusion Guidance: (Specific Instructions)

Contents

Acquisition Parameters

[What mode to use?](#)

CT Perfusion Coverage

[256 \(Revolution CT\) slice coverage](#)

[80 mm shuttle mode coverage](#)

[Less than 80 mm coverages](#)

Acquisition Parameters

Scan modes for perfusion will vary based on scanner model, scanner options, and perfusion scan range.

What mode to use?

- Is your scanner a Revolution CT, Revolution CT ES, or a Revolution Apex?
 - If yes, use the table labeled "Revolution 256" below which uses a 80 mm collimation and an axial scan mode
 - This scanner doesn't require you to change modes in order to use larger (e.g., 120, 140, or 160 mm) or smaller (e.g., 40 mm) perfusion scan range.
- Does your scanner have shuttle mode?
 - If yes, use a protocol from the section labeled "Shuttle mode capable scanners" which uses an 80 mm shuttle scan range
 - This mode doesn't allow for coverages smaller than 80 mm. If you desire a smaller coverage (e.g., on a pediatric patient) you need to use the instructions below for axial mode. While this mode allows for more than 80 mm of coverage (i.e., the shuttle mode allows up to 120 mm), we recommend 80 mm.
- Does your scanner not have shuttle mode and it is not a Revolution CT, Revolution CT ES, or a Revolution Apex?
 - If yes, use the a protocol from the section labeled "Axial mode perfusion protocols" where we provide parameters for 20 or 40 mm axial mode coverage

You should never use "CINE" mode for perfusion scanning. CINE mode does not allow for gaps between acquisitions. This means the beam is always on, which is not needed for perfusion. Each table below has parameters for both pediatrics (infant/child 0-6 years old) and adults. Adolescents ages 7-17 should use the adult parameters. Apply 30% ASiR/ASiR-V to the perfusion recons if your scanner has that option. **The CTDIvol ranges for the protocols listed here varies between ~200 and ~400 mGy depending on scanner. If you program one of these protocols into your scanner and it provides a CTDIvol over 600 mGy something is wrong.** You should consult GE apps or contact our UW team if this occurs. We use a slightly higher mA for wide bore scanners to account for the larger bore size.

Important: Brain Perfusion scan durations should last for approximately 65 to 70 seconds and have at least 22 passes. In order to achieve this in Axial mode you will adjust several parameters: rotation time, interscan delay, and the number of images. We have included a row for "total number of images" in our Axial Perfusion Mode Parameter Tables. While we understand that "number of images" is not typically a parameter set by technologists, it is an indirect way to get the scanner to scan a specific number of passes. Do not expect to see a box on the scanner telling you your total perfusion scan time for the "Axial mode perfusion protocols". Your total perfusion scan duration for Axial Mode perfusion scanning will be equal to (22 passes at 0.5 seconds) + (22 passes at 2.5 sec ISD) = 66 seconds.

For scanners with limited coverage (i.e., less than 80 mm) you may want to consider performing multiple perfusion scans with separate contrast injections. Consult a physician at your institution to build such a protocol.

One of the most common errors made in setting up these protocols is entering a non-zero interval for an axial mode perfusion scan. If you do this, the scanner WILL NOT scan the same coverage. A protocol set with a non-zero interval in axial mode will index the couch/table between each perfusion pass --> we do not want this. So please be sure the interval is "0" for axial mode scans. For shuttle mode scans, the interval value will be set by the scanner based on the scan range selection (e.g., for an 80 mm shuttle perfusion the interval is 40 mm).

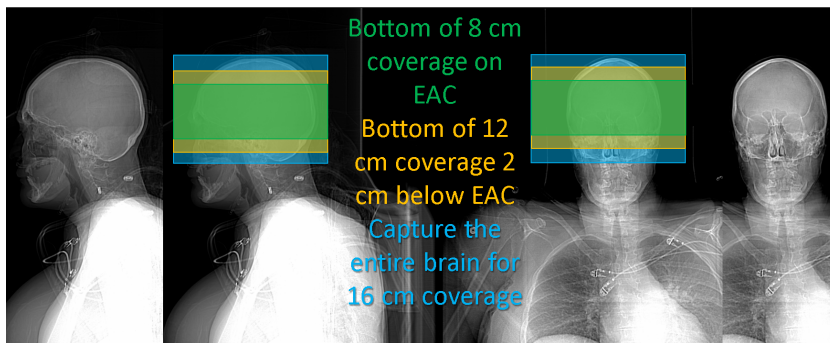
For pediatrics, UW protocols ship with a default Axial scan range of 40 mm. In many cases 80 mm of coverage is too much for small patients. Therefore, even if the scanner has shuttle mode, for pediatrics we use axial mode in order to obtain a 40 mm collimation. If you require a larger collimation for your pediatric patients, you will have to change to shuttle mode if your scanner has that option. If your scanner doesn't have shuttle mode and you require a collimation larger than 40 mm, you will have to perform two contrast bolus injections and you should consult a physician to discuss. See instructions below for guidance.

	Revolution256	Shuttle mode capable scanners (wide bore)	Shuttle mode capable scanners (regular bore)
Scan Type	Axial	Shuttle	Shuttle
Rotation Time	0.35	0.5	0.5
Beam Collimation (mm)	80	40	40
Detector Rows	128	64	64
Detector Configuration	128 x 0.625	64 x 0.625	64 x 0.625
Scan FOV	Head	Head	Head
Number of images per rotation	16i	8i	8i
kV	80	80	80
Smart or Manual mA	Manual mA	Manual mA	Manual mA
Manual mA for Adults	500	360	300
Manual mA for Ped	285	180	150
Duration (sec)	65	65	65
# of Passes	22	22	22
Slice Thickness (mm)	5.0	5.0	5.0
Interval (mm)	0	Determined by scan range	Determined by scan range
ASiR	30%	30%	30%
Total Number of images	You don't need to set this, it is chosen for you when you set up the perfusion protocol.	You don't need to set this, it is chosen for you when you set up the perfusion protocol.	You don't need to set this, it is chosen for you when you set up the perfusion protocol.
ISD (interscan delay)	Adjust the field named "Minimum Time Between Passes" until scan time reaches ~65 seconds. For 0.35 second rotation time and 22 passes, this value will be 2.8 seconds.	Not used.	Not used.

	Axial mode perfusion protocols (wide bore)	Axial mode perfusion protocols (regular bore)
Scan Type	Axial	Axial
Rotation Time	0.5	0.5
Beam Collimation (mm)	as large as possible	as large as possible
Detector Rows	as large as possible	as large as possible
Detector Configuration	as large as possible	as large as possible
Scan FOV	Head	Head
Number of images per rotation	(8i for 40 mm, 4i for 20 mm)	(8i for 40 mm, 4i for 20 mm)
kV	80	80
Smart or Manual mA	Manual mA	Manual mA
Manual mA for Adults	360	300
Manual mA for Ped	180	150
Duration (sec)	~65	~65
# of Passes	22	22
Slice Thickness (mm)	5.0	5.0
Interval (mm)	0	0
ASiR	30%	30%
Total Number of images	This needs to be equal to 22x(beam collimation/5). So for a 20 mm scanner, it will be 88 images. For a 40 mm scanner, it will be 176.	This needs to be equal to 22x(beam collimation/5). So for a 20 mm scanner, it will be 88 images. For a 40 mm scanner, it will be 176.
ISD (interscan delay)	2.5 seconds	2.5 seconds

CT Perfusion Coverage

256 (Revolution CT) slice coverage



Perfusion Coverage Guidance. If a "whole brain" coverage is ordered, use the 16 cm coverage. Note, on non Rev256 scanners, you will only have 8 cm of coverage (i.e. shuttle mode). All three protocols will have the same scan time, approximately 60 seconds. 80 mm coverage = 352 images, 120 mm coverage = 528 images and 160 mm coverage = 704 images. Normal stroke workup, even on a 16 cm capable wide axial scanner should only use 80 mm coverage. The >80 mm coverage should be requested specifically by the ordering physician.

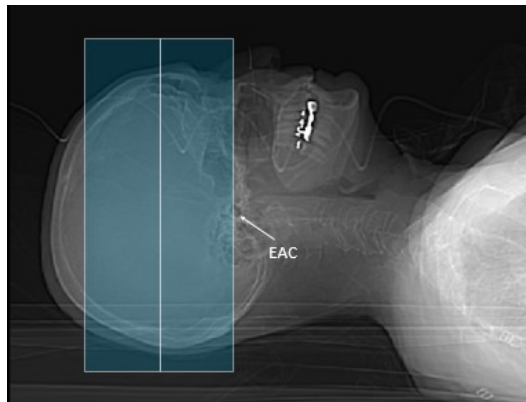
80 mm shuttle mode coverage

Obtain 16 contiguous 5 mm slices from EAC Upward

Less than 80 mm coverages

- We do not recommend doing perfusion with scanners having less than 40 mm coverage. Ideally, you should not use a scanner providing less than 80 mm of coverage.
- Coverages for <80 mm should be prescribed by the ordering physician. We provide some example images below of commonly ordered scan ranges.
- UW recommends a two-level CT Brain Perfusion approach for scanners with a max of 40 mm collimation. Due to the limitations of your scanners perfusion coverage, if the radiologist requires more coverage than the 40 mm allowed by the scanner, you will need to load 40 additional mLs of contrast in order to perform two separate injections, five minutes apart, two separate 40mm perfusion coverages with no overlap or gaps.

Scan in two separate series, **we recommend naming each series using "BOTTOM SLAB"/ "TOP SLAB" or explicit coverage description** for differentiation purposes. This is important not only for the radiologists, but also for RAPID AI perfusion post-processing.

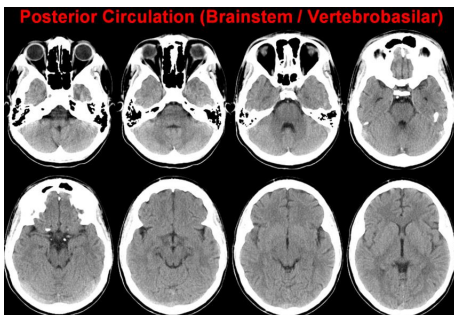


Two level perfusion in two series

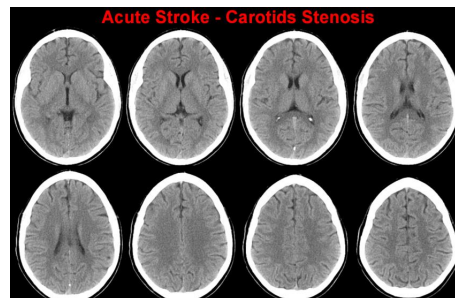
Two level perfusion: Bottom Slab starts at EAC, Top Slab starts at end location of Bottom Slab

- Guidance on how to build/ perform the two-level perfusion protocol:

1. Load enough contrast for two perfusion injections plus the CTA injection (usually 200 mL contrast and 200 mL saline)
2. Start scans at EAC, scanning bottom up. You will acquire the Posterior Circulation (Brainstem/Vertebrobasilar) level first with 40 mL of contrast.
3. **Wait 5 minutes**
4. Next series **Start scans at the "END LOCATION" of perfusion 1**, scanning bottom up. You will now acquire the Acute Stroke (Carotid Stenosis) level. Inject AN ADDITIONAL 40 mL of contrast, with the **same timing (5 second prep)** as the first perfusion you just performed. We cannot have an overlap or gap in coverage between the 2 perfusion slabs, so you must enter your start location for the second perfusion group/ series as the end location of your first perfusion group/series.



4 cm coverage for Posterior Circulation (Brainstem/Vertebrobasilar)



4 cm coverage for Acute Stroke (Carotid Stenosis)

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