

AAPM Continuing Education Program

Computed Tomography 4

CT Dose Reduction Strategies and the Pediatric Patient

August 14, 2003

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This set of handout materials is intended to provide the course participants with several current examples of Pediatric CT Protocol charts in use in several national centers for reference.

Note the variation in the size parameter used to designate different CT protocols. Some centers use the patient's age only, others use a combination of age and weight, and one uses only the CT image display field of view.

Most centers employ 120 kVp exclusively, but not all. Some protocol charts include contrast administration information, others do not.

All protocol charts specify kVp, mA and rotation time, pitch, and image thickness parameters, based on patient size. Most also include reconstruction algorithm (or "kernel") information.

The course instructor and AAPM wish to thank the physicists and clinicians who were willing to share this information for educational purposes.

UCLA Pediatric CT Protocols

Master List

1. Pediatric Chest – Imaging for Metastatic Disease

Age	lbs	mA	Time (s)	kVp	Collimation	Pitch	Algorithm
neonate	< 10	30	1	120	3 mm	1.0	Bone/Sharp
<6yrs	10-19	40	1	120	3 mm	1.0	Bone/Sharp
<6yrs	20-39	50	1	120	3 mm	1.0	Bone/Sharp
<6yrs	40-59	60	1	120	3 mm	1.0	Bone/Sharp
> 6yrs	60-79	70	1	120	3 mm	1.0	Bone/Sharp
> 6yrs	80-99	80	1	120	3 mm	1.0	Bone/Sharp
> 6yrs	100-150	100-120	1	120	3 mm	1.0	Bone/Sharp
> 6yrs	>150	>140	1	120	3 mm	1.0	Bone/Sharp

2. Routine Pediatric Chest

Age	lbs	mA	Time (s)	kVp	Collimation	Pitch	Algorithm
neonate	< 10	30	1	120	3 mm	1.5	Bone/Sharp
<6yrs	10-19	40	1	120	5 mm	1.5	Bone/Sharp
<6yrs	20-39	50	1	120	5 mm	1.5	Bone/Sharp
<6yrs	40-59	60	1	120	5 mm	1.5	Bone/Sharp
> 6yrs	60-79	70	1	120	7 mm	1.5	Bone/Sharp
> 6yrs	80-99	80	1	120	7 mm	1.5	Bone/Sharp
> 6yrs	100-150	100-120	1	120	7 mm	1.5	Bone/Sharp
> 6yrs	>150	>140	1	120	7 mm	1.5	Bone/Sharp

3. Routine Pediatric Abdomen

Age	lbs	mA	Time (s)	kVp	Collimation	Pitch	Algorithm
neonate	< 10	50	1	120	3 mm	1.5	Std
<6yrs	10-19	60	1	120	5 mm	1.5	Std
<6yrs	20-39	70	1	120	5 mm	1.5	Std
<6yrs	40-59	80	1	120	5 mm	1.5	Std
> 6yrs	60-79	100	1	120	7 mm	1.5	Std
> 6yrs	80-99	120	1	120	7 mm	1.5	Std
> 6yrs	100-150	140-150	1	120	7 mm	1.5	Std
> 6yrs	>150	>170	1	120	7 mm	1.5	Std

ROUTINE CT PROTOCOLS

SEDATION: <2 YR CHLORAL HYDRATE 80 mg/kg PO -MAX OF 2000 mg
PRN IM/IV or IV/IV as below

➤ 2 YR IV OR IM PREMED -- MORPHINE/OR FENTAYL
FOLLOW PRN WITH IV NEMBUTAL MAX 5 MG/KG (200mgMAX)

IV INFUSION

22 gauge catheter	1 cc/sec
20 gauge catheter	1.5 cc/sec
18 gauge catheter	2 cc/sec
< 22 gauge catheter	HAND PUSH

IV DOSE: maximum dose = 120cc

CHEST	AGE	SLICE /PITCH	IMAGE	kVp=120 Kg -----mA
	<3yr	5mm: 1.5 pitch	infusion complete	4.5-8.9 ----40
	4-10 yr.	7mm: 1.5 pitch	infusion minus 5 sec	9.0-17.9----50
	>10 yr.	7mm: 1.5 pitch	infusion minus 5 sec	18-26.9 ----60
				27-35.9 ----70
				36-45 -----80
				45.1-70 ---100
				>70-----140

IV DOSE: 1.5 CC/Kg

CHEST --HIGH RESOLUTION ONLY

NO IV-----1MM SLICES at above intervals for age
 INHALATION/ EXHALATION- 1 mm images at aortic arch, carina, lung bases
 USE FOR: bronchiectasis/ bronchiolitis obliterans/ cystic fibrosis, histiocytosis,
 tuberous sclerosis

CHEST PLUS ABDOMEN/ PELVIS IV DOSE: 2.5 CC/Kg

Begin: top of chest---continue helically through C>A>P---use usual slice thickness/pitch
 for that age child ----begin imaging at infusion plus 5 sec

ABDOMEN/PELVIS		IV DOSE: 2.0 CC/Kg	IMAGE	kVp=120 Kg -----mA
AGE	ORAL DOSE X 3q 30min	SLICE/PITCH		
<1 mo.	1-1.5oz q 30 x3	5mm: 1:1	plus 15 sec	4.5-8.9----60
1mo-1yr.	3-4 oz q 30 x 3	5mm: 1.5	plus 15 sec	9.0-17.9---70
1-2 yr.	4-5 oz q 30 x 3	5mm: 1.5	plus 15 sec	18-26.9----80
2-5 yr.	6-oz q 30 x 3	7mm: 1.5	plus 25 sec	27-35.9---100
5-10 yr.	8-oz q 30 x 3	7mm: 1.5	plus 25 sec	36-45----120
10-12 yr.	10-oz q 30 x 3	7mm: 1.5	plus 25 sec	45.1-70---140
12-20 yr.	12 oz q 30 x 3	7mm: 1.5	plus 25 sec	>70-----170

POST TRAUMA ABD/PELVIS

As above for age --IV ONLY-water or oral contrast if ER Doc/Radiologist say OK

BONE MARROW TRANSPLANT- R/O fungal lesion--liver/ spleen/ kidneys- IV ONLY---NO ORAL--see abdomen/pelvis above for slice thickness and mA.

RENAL STONES- 5mm /1.5 abd/pelvis with 3mm reconstruction No IV / No oral

PULMONARY EMBOLI-IV=2-3CC/SEC 3mm slices--1.5 mm reconstructions.

Pitch 2:1- begin at lung bases-image at infusion start plus 15-20 seconds.

BREATHHOLD

Lynn Trautwein, MD

Pediatric protocols routinely used in Johns Hopkins Medical Institutions
 Mahadevappa Mahesh, Ph.D.

Abdomen		CTA (vascular or dual phase)			Routine Chest	
kV	120	80			120	
Effective mAs	*	*			*	
Slice collimation	1.5 mm	0.75 mm		1.5 mm		
Slice width	5.0 mm	0.75 mm	2nd recon	5.0 mm	2nd recon	
	5.0 mm	3.0 mm	3rd recon	3.0 mm	5.0 mm	
Feed / Rotation	24.0 mm	18.0 mm		18.0 mm	24.0 mm	
Rotation time	0.5 sec	0.5 sec		0.5 sec	0.5 sec	
Kernel	B30f	B30f	B30f	B30f	B80f	
Increment	5.0 mm	5.0 mm	3.0 mm	3.0 mm	5.0 mm	
Image Order	cr-ca	cr-ca	Lung	Lung	cr-ca	
Comment:	* The mAs should be adjusted to the body weight of the child:	Comment: The above is for the arterial phase. You will also scan a venous phase using the same recon jobs except recon #3 will be B30f kernal using a liver window.		Comment: * The mAs should be adjusted to the body weight of the child:		
	1. < 15 kg : kV:120, mAs: 30-40	* The mAs should be adjusted to the body weight of the child:		1. < 15 kg : kV:120, mAs: 17		
	2. 15-24 kg : kV: 120, mAs: 50-65	1. < 15 kg : kV:80, mAs: 70		2. 15-24 kg : kV: 120, mAs: 20-40		
	3. 25-34 kg : kV: 120, mAs: 65-80	2. 15-24 kg : kV: 80, mAs: 80		3. 25-34 kg : kV: 120, mAs: 30-50		
	4. 35-44 kg : kV: 120, mAs: 90 -110	3. 25-34 kg : kV: 80, mAs: 100		4. 35-44 kg : kV: 120, mAs: 50-80		
	5. 45-54 kg : kV: 120, mAs: 120- 140	4. 35-44 kg : kV: 80, mAs: 120		5. 45-54 kg : kV: 120, mAs: 70-100		
		5. 45-54 kg : kV: 80, mAs: 180				
Provided courtesy of Mahadevappa Mahesh, Ph.D.						

Pediatric protocols routinely used in Johns Hopkins Medical Institutions

	HRCT-Spiral	Routine Head Study-Spiral	Sequential
kV	120	120	120
Effective mAs	*	*	*
Slice collimation	0.75 mm	1.5 mm	1.5 mm
Slice width	2.0 mm	5.0 mm	4.5 mm
	2nd recon 2.0 mm	2nd recon 5.0 mm	2nd recon
Feed / Rotation	18.0 mm	11.8 mm	18.0 mm
Rotation time	0.5 sec	0.75 sec	0.75 sec
Kernel	B80f	C30s	C60s
Increment	5 mm	5.0 mm	N/A
Image Order	cr-ca	ca-cr	ca-cr
	<p>Comment: * The mAs should be adjusted to the body weight of the child: 1. < 15 kg: kV:120, mAs: 17 2. 15-24 kg : kV: 120, mAs: 20-40 3. 25-34 kg : kV: 120, mAs: 30-50 4. 35-44 kg: kV: 120, mAs: 50-80 5. 45-54 kg: kV: 120, mAs: 70-100</p>	<p>Comment: Cannot angle gantry when spiraling. * The mAs should be adjusted to the age 1. < 6 mo: kV:120, mAs: 90 2. 6 mo. - 3 years: kV: 120, mAs: 150 3. 3 years - 6 years: kV: 120, mAs: 220</p>	<p>Comment: * The mAs should be adjusted to the body weight of the child: 1. < 6 mo: kV:120, mAs: 90 2. 6 mo. - 3 years: kV: 120, mAs: 150 3. 3 years - 6 years: kV: 120, mAs: 220</p>

[Provided courtesy of Mahadevappa Mahesh, Ph.D.]

Division of Diagnostic Imaging
PEDIATRIC CT CHEST PROTOCOL

FINAL VERSION

NAME: _____

ID #: _____

DATE: _____

AGE _____ WEIGHT in **Kg**: _____ NEEDLE SIZE # _____

Allergies _____

BUN: _____ CREAT _____ DATE _____

(LABS NOT REQUIRED FOR OUTPATIENTS)

_____ CHEST _____ ABDOMEN _____ PELVIS _____ OTHERS (Use Appropriate protocols)

_____ I.V. CONTRAST _____ ORAL _____ 1ST STUDY _____ PRE **No Routine Rectal Contrast in Peds**

Volume: _____
 1 ml / Kg For Chest only, (max 100 ml)
 2 ml / Kg For A, AP, or C/A/P, (max 150 ml)

Delay: _____
 25 Seconds for Chest only, Scan Apex to Bases
 25 Seconds for C/A/P (pause between C&A to arrive at liver ~60 seconds): Scan Apex to Pubis
 25 Seconds for C/A (pause between C&A to arrive at liver ~ 60 seconds): Scan Apex to Crest

Rate: _____
 0.3 To 3.0 ml / seconds for #24, #22, #20, #18 gauge needles
 0.5 To 0.8 ml/ seconds for Central lines

CHEST

For Technologists' Use Only

LS = CT3, CT5, CT6, CT12

LS+ = CT2, CT4, CT14, CT15

DFOV	Image Thickness	Helical Mode	Table Travel	kVp	LS mA	LS Sec	LS+ mA	LS+ Sec	Chest Recons
Up to 21 cm	5 mm	HS	15 mm	100	90	0.8	140	0.5	2.5 mm
22 cm to 23 cm	5 mm	HS	15 mm	100	120	0.8	190	0.5	2.5 mm
24 cm to 26 cm	7.5 mm	HQ	11.25 mm	100	70	0.8	110	0.5	3.75 mm
27 cm to 29 cm	7.5 mm	HQ	11.25 mm	100	80	0.8	130	0.5	3.75 mm
30 cm to 35 cm	7.5 mm	HQ	11.25 mm	120	90	0.8	140	0.5	3.75 mm

- HS = 1.5:1, HQ = 0.75:1
- Please get all contrast in, as scan begins.
- Filming for Soft Tissues: Either 300/70, or 500/50 depending on body fat. Please use your judgment.
- For Lung Window/ level please use lung algorithm
- Please use appropriate shielding.

Please use MANUAL breathing instructions.

DFOV should include ALL anatomy.

If DFOV is changed from previous exam note the reason on your worksheet.

Special Instructions _____

Radiologist's stamp, signature and Number: _____ Date _____ Time _____

Provided Courtesy of Dianna Cody, Ph.D. & Donna Moxley, M.S.

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**PEDIATRIC CT ABDOMEN/PELVIS
 PROTOCOL**

FINAL VERSION

NAME: _____

ID #: _____

DATE: _____

AGE _____ WEIGHT in Kg: _____ NEEDLE SIZE # _____

Allergies _____

BUN: _____ CREAT _____ DATE _____

(LABS NOT REQUIRED FOR OUTPATIENTS)

_____ CHEST _____ ABDOMEN _____ PELVIS _____ OTHERS (Use Appropriate protocols)

_____ I.V. CONTRAST _____ ORAL _____ 1ST STUDY _____ PRE **No Routine Rectal Contrast in Peds**

Volume: _____ 2 ml / Kg For A, AP, or C/A/P, (max 150 ml)

Delay: _____ 25 Seconds for C/A/P (pause between C&A to arrive at liver ~60 seconds): Scan Apex to Pubis
 25 Seconds for C/A (pause between C&A to arrive at liver ~ 60 seconds): Scan Apex to Crest
 50 Seconds for A or A/P: Scan Diaphragm to Crests or Diaphragm to Pubis

Rate: _____ 0.3 To 3.0 ml / seconds for #24, #22, #20, #18 gauge needles
 0.5 To 0.8 ml/ seconds for Central lines

Abdomen/Pelvis

For Technologists' Use Only

LS = CT3, CT5, CT6, CT12

LS+ = CT2, CT4, CT14, CT15

DFOV	Image Thickness	Helical Mode	Table Travel	kVp	LS: mA	LS: Sec	LS+: mA	LS+: Sec
Up to 21 cm	5 mm	HS	30 mm	100	90	0.8	140	0.5
22 cm to 23 cm	5 mm	HS	30 mm	100	120	0.8	190	0.5
24 cm to 26 cm	7.5 mm	HS	30 mm	100	130	0.8	200	0.5
27 cm to 29 cm	7.5 mm	HS	30 mm	100	160	0.8	260	0.5
30 cm to 35 cm	7.5 mm	HS	30 mm	120	180	0.8	280	0.5

- HS = 1.5:1, HQ = 0.75:1
- Please get all contrast in, as scan begins.
- Filming for Soft Tissues: Eüher 300/70, or 500/50 depending on body fat. Please use your judgment.
- For Lung Window/ level please use lung algorithm
- Please use appropriate shielding.

Please use MANUAL breathing instructions.

DFOV should include ALL anatomy.

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