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Paediatric CT Practice - How safe is imaging in different countries?

Radiation protection in paediatric computed tomography in Serbia

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1. List of the facility's CTDI and DLP for children from different age groups

Data on patient dose in paediatrics CT in Serbia have been systematically collected and are presented in Tables 2-4. Characteristics of CT units and collection periods are given in Table 1.

Table 1: Characterisctics of CT units.

Hospital	Manufacturer/ Model of scanner	No of detector rows	Year of installation	Data collection period
University Children's Hospital	Siemens Somatom Emotion 16	16	2008	May 2010–Jun 2011
Institute for child's and mother's health	Toshiba Aquilion 16	16	2009	Jun 2010–Jan 2011
Institute of children's and youth's health in Vojvodina	General Electric BrightSpeed S	16	2008	Jun 2010–Dec 2010

Table 2: $CTDI_{vol}$ and DLP values in head CT examination.

HEAD		$CTDI_{vol}$ [mGy]			DLP [mGy·cm]		
		mean ± sd (min - max)					
		hospital A	hospital B	hospital C	hospital A	hospital B	hospital C
age group	0-1	15 ± 1 (14 - 17)	27 ± 4 (25 – 33)	27 ± 7 (8 – 30)	247 ± 28 (200 –288)	452 ± 134 (196 – 726)	402 ± 176 (125 – 714)
	1-5	19 ± 1 (16 – 20)	44 ± 16 (16 – 57)	34 ± 9 (21 – 44)	335 ± 43 (247 – 408)	958 ± 472 (98 – 1659)	565 ± 265 (339 – 1255)
	5-10	21 ± 2 (17 – 23)	50 ± 14 (20 – 61)	35 ± 9 (21 – 45)	507 ± 193 (270 – 792)	906 ± 512 (104 – 1602)	576 ± 156 (320 – 727)
	10-15	23 ± 1 (21 – 25)	68 ± 33 (16 – 92)	38 ± 6 (28 – 45)	609 ± 237 (386 – 930)	1232 ± 922 (257 – 2481)	608 ± 118 (452 – 852)

Table 3: $CTDI_{vol}$ and DLP in chest CT examination.

CHEST		$CTDI_{vol}$ [mGy]			DLP [mGy·cm]		
		mean ± sd (min - max)					
		hospital A	hospital B	hospital C	hospital A	hospital B	hospital C
age group	0-1	3 ± 0 (3 – 3)	4 ± 0 (4 – 4)	5 ± 2 (4 – 9)	90 ± 0 (90 – 90)	86 ± 4 (83 – 88)	147 ± 75 (50 – 238)
	1-5	3 ± 0 (3 – 3)	4 ± 3 (2 – 13)	6 ± 2 (4 – 8)	130 ± 52 (54 – 191)	77 ± 37 (13 – 126)	179 ± 109 (112 – 305)
	5-10	4 ± 1 (3 – 5)	5 ± 4 (2 – 13)	4.7 ± 0.3 (4.5 – 5.0)	127 ± 56 (64 – 227)	129 ± 86 (58 – 274)	167 ± 83 (115 – 263)
	10-15	5 ± 2 (4 – 8)	6 ± 3 (2 – 14)	5 ± 2 (1 – 7)	197 ± 114 (73 – 454)	238 ±155 (38 – 433)	360 ± 270 (30 – 955)

Table 4: $CTDI_{vol}$ and DLP in abdomen CT examination.

ABDOMEN		$CTDI_{vol}$ [mGy]			DLP [mGy·cm]		
		mean ± sd (min - max)					
		hospital A	hospital B	hospital C	hospital A	hospital B	hospital C
age group	0-1	3 ± 1 (3 – 4)	13 ± 0 (13 – 13)	4 ± 0 (4 – 4)	153 ± 32 (120 – 191)	226 ± 141 (126 – 326)	195 ± 37 (166 – 237)
	1-5	4 ± 1 (2 – 4)	6 ± 3 (2 – 13)	6 ± 2 (4 – 8)	184 ± 52 (102 – 228)	194 ± 86 (131 – 344)	362 ± 319 (109 – 817)
	5-10	7 ± 2 (4 – 10)	5 ± 1 (3 – 6)	9 ± 0 (9 – 9)	408 ± 305 (172 – 851)	137 ± 110 (54 – 327)	527 ± 98 (457 – 596)
	10-15	6 ± 1 (4 – 8)	5 ± 1 (3 – 6)	6 ± 1 (5 – 7)	403 ± 197 (125 – 579)	319 ± 152 (124 – 496)	725 ± 326 (419 – 1211)

Data given in Tables 2–4 are from two publications:

Vassileva J. et al, IAEA survey of pediatric CT practice in 40 countries in Asia, Europe, Latin America, and Africa: Part 1, frequency and appropriateness. AJR, 2012 198: 1021 – 1031.

Vassileva J. et al, IAEA survey of paediatric computed tomography practice in 40 countries in Asia, Europe, Latin America and Africa: procedures and protocols. European Radiology, 2013 23(3):623-31.

2. Information to indicate how radiation protection is promoted and practised

www.dzz.org.rs/edukativni-materijali

3. How radiation protection during paediatric CT is practised in the facility

There are four dedicated paediatric hospitals in Serbia and three of them are CT equipped. Hospitals perform CT examinations exclusively on paediatric patients and therefore protocols are dedicated to children. Bismuth and lead protective equipment is available in all three hospitals. Training in radiation protection is regularly performed every five years for radiology staff. However, medical staff are obliged to renew their licences for work and some licensed programmes are in the radiation protection field. Radiology staff are also very cooperative in finding solutions for protocol optimisation.

4. Assessment of the number of paediatric CT examinations that lack appropriateness

Radiology staff in CT-equipped paediatric hospitals were recently surveyed about inappropriate CT examinations. The estimated percentage of inappropriate CT scans was very high, especially in head examinations. In one of the hospitals, 170 CT examinations of 578 in total performed on children in last year were declared as unnecessary. The other hospital estimated that 86% of all head CT exams were inappropriate. The results of this investigation have not been published so far.

5. Data on the percentage of dose reduction in CT of children

After the first data paediatric CT collection in Serbia, the data were presented to hospitals, and on that occasion hospital B expressed their intention to reduce dose values. For protocol optimisation, the manufacturer's engineer was employed. There are no medical physicists in diagnostic radiology departments in Serbia and, therefore, a physicist was not present during the optimisation process. The results of such activity led to a higher exposure level for children of all ages. Dose indicators, $CTDI_{vol}$ and DLP, for child under the age of one year in head exam are now higher than DRL for adults (according to EUR16262). The hospital was informed of this and new protocol optimisation is going to be performed. However, this time an engineer will be working together with a medical physicist from an external technical service.

6. How we child size our CT imaging

Protocols are divided into groups according to patient age on all three CT units. Age bands are created by manufacturers and are different on each CT unit and also depend on the body part to be examined. Patient size is taken into account by using different automatic exposure control systems on each unit.

7. Number of paediatric CT referrals that are reviewed by radiologists before giving appointments

Results from the recent survey conducted in paediatric hospitals on the appropriateness of child scans show that greater availability of MRI devices could decrease the number of CT scans. A significantly higher number of head examinations, compared to the total number of examinations, has been observed in institutions that are not equipped with an MRI units. Unfortunately, only one hospital has an MRI unit at the moment. Radiology staff, in general, demonstrate an great level of awareness of radiation risks, appropriateness criteria and their responsibilities in radiation protection of children. However, when it comes to the justification decision in the case of a particular child, they rarely decide not to perform the examination. Therefore, special attention should be paid to awareness of other medical specialties that refer children to CT, such as paediatricians and surgeons. The results of this investigation have not been published so far.