



Potential for optimization of pediatric chest X-ray examination

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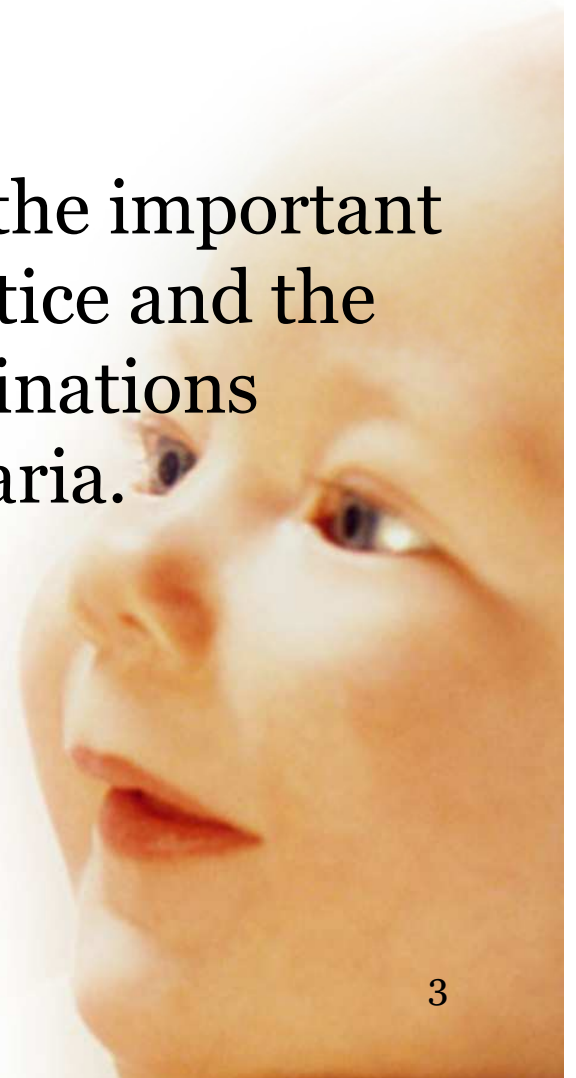
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Introduction

Pediatric patients have a higher probability for late radiation effects and they are assumed to be 2-3 times more radiation sensitive compared to adults, because of the combination of their longer life expectancy with the higher radiation sensitivity of the developing organs.

Purpose

A study was undertaken to compare the important aspects of pediatric radiological practice and the patient doses from chest X-ray examinations performed in three hospitals in Bulgaria.



Materials and Methods

- Data for 163 pediatric patients were recorded using a questionnaire that included:
 - patient's age, height, weight, gender, exposure parameters, radiographic technique and displayed KAP (air kerma-area product) values.
- Five age groups were studied:
 - 0-1 month, 1-12 months, 1-4 years, 5-9 years and 10-15 years.
- Entrance surface air kerma (ESAK) to patient was calculated from the KAP and field size measurements.

Results

Age group	X-ray unit	KAP, $\mu\text{Gy}\cdot\text{m}^2$			ESAK, mGy		
		MIN	MAX	AV	MIN	MAX	AV
1-12 months	Sof_hos_MER_1	4.17	39.85	16.04	0.13	0.69	0.45
	Sof_hos_PRI_3	2.09	4.81	3.32	0.09	0.19	0.15
1-4 years	Sof_hos_MER_1	2.79	8.65	5.74	0.06	0.27	0.17
	Sof_hos_DUN_2	1.99	8.78	7.11	0.06	0.23	0.16
	Sof_hos_PRI_3	2.64	9.79	4.74	0.07	0.31	0.15
5-9 years	Sof_hos_MER_1	5.40	47.22	13.31	0.09	0.72	0.22
	Sof_hos_DUN_2	3.25	8.52	6.23	0.06	0.13	0.11
	Sof_hos_PRI_3	3.45	11.18	6.66	0.44	1.15	0.71
10-15 years	Sof_hos_MER_1	4.22	65.25	22.35	0.10	1.58	0.31
	Sof_hos_PRI_3	5.43	33.02	15.96	0.10	0.40	0.21

MIN - minimum value, MAX - maximum value, AV - average value

Large variations, up to a factor of 5, were found for KAP and ESAK values between the different age groups in a particular X-ray room and up to 7 times between two of the hospitals within the age group 5-9 years.

Results

Age group	X-ray unit	Imaging parameters					
		kV			mAs		
		MIN	MAX	AV	MIN	MAX	AV
1-12 months	Sof_hos_MER_1	54	64	59	2.4	5.0	4.2
	Sof_hos_PRI_3	65	70	68	3.5	6.7	4.9
1-4 years	Sof_hos_MER_1	55	62	59	3.1	8.0	5.4
	Sof_hos_DUN_2	44	57	52	3.2	8.8	6.3
	Sof_hos_PRI_3	65	70	68	3.7	8.0	5.4
5-9 years	Sof_hos_MER_1	55	63	58	6.3	22.6	9.0
	Sof_hos_DUN_2	44	62	55	3.2	4.3	3.8
	Sof_hos_PRI_3	65	78	70	5.0	12.0	6.6
10-15 years	Sof_hos_MER_1	55	72	61	6.3	24.5	11.2
	Sof_hos_PRI_3	68	78	73	4.0	16.0	8.5

MIN - minimum value, MAX - maximum value, AV - average value

Some variations in exposure parameters and procedures for the patients of the same size were found between the hospitals and even in the same hospital.

Results

Age group	X-ray unit	Film size, cm		Field size on table					
		x	y	x			y		
				MIN	MAX	AV	MIN	MAX	AV
1-4 years	Sof_hos_DUN_2	24	30	24	33	30	23	31	27
5-9 years	Sof_hos_MER_1	24	30	24	41	31	23	43	32
	Sof_hos_DUN_2	24	30	31	34	33	29	36	32
10-15 years	Sof_hos_MER_1	35	35	21	50	38	26	54	43
	Sof_hos_PRI_3	35	35	27	41	34	29	46	36

MIN - minimum value, MAX - maximum value, AV - average value

Inappropriate film size and insufficient collimation were often used by the radiographers.

Results

- In one of the hospitals the automatic exposure control was used with all the chambers (lateral and central) selected in almost all of the cases regardless of the patient's age.
- In two of the hospitals anti-scatter grid was always used for children younger than 5 years.
- No attention was paid in most cases to reduce dose to the sensitive organs by means of shields or proper collimation.
- There is no routine practice to register patient doses and to inform parents for the received dose.

Conclusions

- The collected detailed data for exposure parameters and procedures provided information how the patient doses in pediatric chest radiography can be reduced.
- Recommendations were given:
 - for proper use of automatic exposure control and anti-scatter grid;
 - for use of optimal exposure parameters, especially tube kilovoltage;
 - utilizing additional Cu-filtration when available;
 - when possible, PA projection should be generally utilized.

