ID P035: Dose Optimization in Pediatric Interventional Cardiology

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Abstract

Purpose : The present study aims to determine radiation dose as well as to estimate the effective dose, in a large number of pediatric interventional cardiology diagnostic and therapeutic procedures, in the context of the optimization of radiation protection. **Methods:** Data from 410 cases have been grouped in diagnostic and therapeutic procedures, according to patient age; Four age groups were used: less than one years old, between 1 and 5 years old, more than 5 to 10 years old and more than 10 to 16 years old. Kerma Area Product P_{KA} , fluoroscopy time and the number of images were recorded and effective doses were calculated using appropriate conversion factors.
Results : The recorded median P_{KA} values are 2 and 1.8, 3 and 3.6, 6 and 7, 12.4 and 11.5 Gycm^2 respectively, for diagnostic and therapeutic procedures and for the four age groups. The respective median estimated values for the effective dose are 7.4 and 6.6, 5.8 and 5.4, 6.8 and 7.1 and 7.6 and 6.8 mSv. The difference between the median P_{KA} values for the diagnostic and therapeutic procedures falls within the statistical variation though there are differences in the maximum values on individual basis. The same observation stands for the estimated values of the effective dose. Moreover, the PKA values are increased as the age is increasing. However, this is not the case for the effective dose values which seem to be stable throughout the age range of the patients. The last observation should not mistakenly lead to the conclusion that the effective dose is the same for all age groups, since some maximum P_{KA} and effective dose values in complex therapeutic procedures are very high. **Conclusions::** In conclusion, it is underlined that though it seems that there is no statistically significant difference between diagnostic and therapeutic procedures for the P_{KA} values and for the estimated values of the effective dose across the age groups examined, there can be specific cases which calls out attention from radiation protection point of view, where the principle of optimization should be strongly implemented.

INTRODUCTION

The radiation exposure issue is particularly significant for infants and children because:

- ❖ Children are more radiosensitive than adults
- ❖ A larger fraction of their body is irradiated
- ❖ There is a probable need to repeat the X- ray procedure

PURPOSE

The present study aims to determine radiation dose as well as to estimate the effective dose, in a large number of pediatric interventional cardiology diagnostic and therapeutic procedures, in the context of the optimization of radiation protection.

METHODS (1)

Data from 410 cases have been grouped in diagnostic and therapeutic procedures, according to patient age; Four age groups were used: less than one year old, between 1 and 5 years old, more than 5 to 10 years old and more than 10 to 16 years old. Kerma Area Product PKA , fluoroscopy time (FT) and the number of images (N) were recorded and effective doses were calculated using appropriate conversion factors.

Eleven types of diagnostic and therapeutic interventional procedures were carried out in Onassis Cardiac Surgery Center:

1. Simple and Complex Diagnostic Catheterization
2. Aortic Angioplasty
3. Pulmonary Artery Angioplasty
4. Pulmonary Artery Angioplasty and Stent placement
5. Atrial Septal Defect (ASD) Occlusion
6. Aortic Valve Dilatation
7. Pulmonary Valve Dilatation
8. Patent Ductus Arteriosus (PDA) Occlusion
9. Electrophysiology Study
10. Radiofrequency Ablation
11. Pacemaker Implantation

METHODS (2)

Table 1. Details on setting for equipment used (Flat Panel Angiography system SIEMENS Zee Biplane

Pediatric Protocol	Patient weight	Antiscatter grid	Acquisition kVp	Fluoroscopy kVp	Acquisition Frames per second	Fluoroscopy Pulses per second
1	< 6 Kg	No	70	57/70	15/30	7.5/10
2	6 to < 20 Kg	No	70	70	15/30	7.5/10
3	20 t0 < 40 Kg	Yes	73	70	15/30	7.5/10

RESULTS (1)

Table 2. Number of cases , per age group per procedure type. Median (range) values of P_{KA} in Gy.cm^2. Median values for Number of Frames (N) Fluoroscopy Time (FT) in min and Effective Dose in mSv.

Age group years old	Type of procedure	# of cases	P_{KA} median (range) Gy·cm^2	N (frames)	FT min	Effective Dose mSv
<1	1. Diagnostic catheterization	54	2 (0.2-65)	1414	5.7	7.4
	2. Therapeutic procedures	27	1.8 (0.3-7.2)	1041	5.2	6.6
1 to <5	1. Diagnostic catheterization	66	3.0 (0.1-3.6)	1403	6.5	5.8
	2. Therapeutic procedures	20	3.6 (0.4-9.4)	1257	4.3	5.4
5 to <10	1. Diagnostic catheterization	33	6.0 (1.0-5.6)	1519	6.2	6.8
	2. Therapeutic procedures	51	7.0 (0.1-196)	772	5.2	7.1
10 to <16	1. Diagnostic catheterization	28	12.4 (1.0-105)	1108	4.4	7.6
	2. Therapeutic procedures	31	11.5 (3.0-128)	1086	4.6	6.8

RESULTS (2)

The difference between the median P_{KA} values for the diagnostic and therapeutic procedures falls within the statistical variation though there are differences in the maximum values on individual basis.
The same observation stands for the estimated values of the effective dose. Moreover, the P_{KA} values are increased as the age is increasing. However, this is not the case for the effective dose values which seem to be stable throughout the age range of the patients. The last observation should not mistakenly lead to the conclusion that the effective dose is the same for all age groups, since some maximum P_{KA} and effective dose values in complex therapeutic procedures are very high.

CONCLUSIONS

In conclusion, it is underlined that though it seems that there is no statistically significant difference between diagnostic and therapeutic procedures for the P_{KA} values and for the estimated values of the effective dose across the age groups examined, there can be specific cases which calls out attention from radiation protection point of view, where the principle of optimization should be strongly implemented.