

### **Short Note**

## **EFFECTIVE DOSE TO CHILDREN DURING CARDIAC CATHETERIZATION**

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**ABSTRACT:** The purpose of this study was to assess the effective dose received by children during cardiac procedures. 6 children from 3 to 14 years old who underwent coronary angiogram, cardiac catheterization and pulmonary valvuloplasty treatment were included in the present study. Measurement of effective doses of the paediatric cardiac patients was performed in four catheterization laboratories in three hospitals. Harshaw TLD badges (TLD-100, LiF: Mg, Ti) were used on patients to measure effective dose in the catheterization laboratory. The TLD badges were calibrated from Secondary Standard Dosimetry Laboratory. It is found that the highest dose was 2.01 mSv in 5.4 minute fluoroscopic time during peripheral angiogram and primary pace maker procedure and the lowest effective dose was 0.044 mSv in 1.2 minute fluoroscopic time during coronary angiography performed in the same hospital. The highest fluoroscopic time (18:14 min) was taken to perform a cardiac catheterization and pulmonary valvuloplasty procedure and the dose was 0.781 mSv. During cardiac catheterization children were exposed to high levels of radiation but there was a variant in dosage. Careful consideration should be given to minimize dosage by practicing ALARA principle. This type of study may lead cardiologist and scientist to improve necessary safety measures to be taken to reduce the exposure to patients and occupational worker.

### **1. INTRODUCTION**

The highest effective dose from human-made ionizing radiation exposure comes from medical diagnosis and treatment. It is a legal requirement to keep the radiation dose “as low as reasonably achievable”, giving consideration to social and economic factors (the ALARA principle). Tissue sensitivity in children is higher and the probability that there may be late radiation effects is also higher. For children the probability of late effects occurring from radiation exposure is 2 to 3 times higher than for adults [1,2]. Therefore, the attention given to radiation protection and quality assurance in paediatric radiology has been increased.

Cardiac catheterization can deliver the greatest dose of X-radiation [3]. Several measurements of effective doses allied to paediatric cardiac patients have been carried out by thermoluminescent dosimetry [4-6]. From the point of view of radiation protection, occupational worker and patient dose measurement are very important. The effective dose measurements for occupational workers are carried out regularly under NSRC rule 1997 in Bangladesh. However, there are no such a rules and regulation or dose measurement for patients till now. The aim of this study is to assess the effective dose to the children during cardiac catheterizations.

### **2. MATERIALS AND METHODS**

6 children from 3 to 14 years old who underwent coronary angiogram, cardiac catheterization and pulmonary valvuloplasty treatment were included in the present study. Measurement of effective doses of the paediatric cardiac patients was performed in four catheterization laboratories in three hospitals namely Bongobondhu Sheikh Mujib Medical University (BSMMU), Euro-Bangla Heart Hospital and United Hospital in Dhaka. Harshaw TLD badges (TLD-100, LiF: Mg, Ti) were used on patients to measure effective dose in the catheterization laboratory. The TLD badges were calibrated from Secondary

Standard Dosimetry Laboratory. Details of the methods were mentioned in the thesis paper [7]. In BSSMU and Euro-Bangla Heart Hospital all procedures were performed on Siemens Axiom Artis coronary angiography system. In United Hospital all procedures were performed on General Electric Innova and Siemens Axiom Artis coronary angiography system in two catheterization laboratories. The X-ray equipments and their main technical parameters are summarized in Table 1. All the X-ray system used were with an under couch tube and an over couch image intensifier, performs under automatic control.

Data were recorded for each procedure including patient's name, sex, age height, weight, blood group and fluoroscopy time. Radiation measurements of TLD badges were performed with a Harshaw-Bicron (Bicron, OH) TLD reader (Model 4500) with a reading cycle of 300°C in the Laboratory of Health Physics Division in Atomic Energy Center Dhaka.

**Table1:** Main technical parameters of X-ray units.

Workplace	X-ray unit	Tube potential (kV)	Total filtration	Frame and Pulse rate/sec.
Bongobondhu Sheikh Mujib Medical University	Siemens Axiom Artis	60 – 115	0.5 mm Cu	15
United Hospital	Siemens Axiom Artis	60 – 115	0.6 mm Cu	20
	GE Innova	70 – 120	2.7 mm Al	20
Euro-Bangla Heart Hospital	Siemens Axiom Artis	60 – 115	0.5 mm Cu	15

### 3. RESULTS AND DISCUSSION

Data were recorded for each procedure, including patient's name, height, weight, age, blood group and fluoroscopy time. Patient's information and their effective doses were presented in Table 2.

**Table2:** Patient's demographic data and effective dose during cardiac catheterization.

Serial number	Patient	Patient's information				Fluoroscopy time (min)	Effective dose (mSv)
		Height (cm)	Weight (kg)	Blood Group	Age (yrs)		
1	A	32	07	O(+ve)	03	11:17	0.266
2	B	92	10	AB(+ve)	03	00:28	0.293
3	C	90	9	-	03	5.4	2.01
4	D	112	18	B(+ve)	06	11:02	0.219
5	E	112	15	O(+ve)	07	18:14	0.781
6	F	159	63	B(+ve)	14	1.2	0.044

It is found from Table 2. that the highest dose was 2.01 mSv in 5.4 minute fluoroscopic time during peripheral angiogram and primary pace maker procedure in BSMMU and the lowest effective dose was 0.044 mSv in 1.2 minute fluoroscopic time during coronary angiography in the same hospital. The highest fluoroscopic time (18:14 min) was taken to perform a cardiac catheterization and pulmonary valvuloplasty procedure in United Hospital, Dhaka.

Even though there are no regulations that limit the radiation dose to the patient. The assumption is that the benefits derived from the procedure offset the risks associated with radiation exposure. However, there is no dose of radiation that can be considered safe or harmless. Since there is no dose of radiation that can be considered safe or harmless, so some protection measure should be taken to reduce the exposure as low as possible. There are some methods of reducing radiation exposure like reducing the fluoroscopic time and the use of pulsed progressive fluoroscopy, a technique that does not cause a reduction in image quality.

This type of study may lead cardiologist and scientist to improve necessary safety measures to be taken to reduce the exposure to patients and occupational worker.

#### 4. CONCLUSIONS

During cardiac catheterization children were exposed to high levels of radiation but there was a variant in dosage. Careful consideration should be given to minimize dosage by practicing ALARA (As Low As Reasonably Achievable). Being a sensitive issue, the guardians of the pediatric cardiac patients as well as the authorities of the hospitals are reluctant to collaborate with this type of study. But effort is going on to make them understand to implement ALARA principle, ultimately which will be benevolent of them, this type of study is badly needed and the situation is changing bit by bit.

#### ACKNOWLEDGMENTS

We thank all the authorities of BSMMU Hospital, Euro-Bangla Hospital and United Hospital for aid in data collection.

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