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Estimation of Occupational Radiation Dose Levels of Interventional Cardiologists of the Philippine Heart Center

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Introduction

The more I learn, the more I learn how little I know.

- ***Socrates***

- Reports of occupational dose monitoring service showed that some interventional cardiologists received relatively high doses compared to the rest
- 95% of interventional cardiology procedures in the country are performed at the Philippine Heart Center

Materials and Methods

Thermofisher MK2 EPD

- Digital electronic personal dosimeter placed at the chest level under the lead gown of the operator
- Low detection limit is 1 μSv, low energy detection threshold is 15 keV, angular response is ±20%, and accuracy is ±10%
- Provides an $H_p(10)$ reading
- Small and lightweight

Materials and Methods

- In a period of 6 months, doses to interventional cardiologists involving 40 coronary angiogram (CA), 14 percutaneous coronary intervention (PCI), and 10 double set-up (DSU) procedures were recorded.
- Dose-area product (DAP) readings from the machine were also recorded for each procedure.
- Demographics of the patients were included in the record for each procedure for survey of patients profile.

Materials and Methods

- The number of procedures performed each day for each interventional cardiologist and the total of procedures each day were recorded.
- The radiation protection and safety practices implemented at the cardiac catheterization laboratories were also observed and recorded.
- Performance testing of the x-ray machines used for interventional cardiology procedures and lead apron testing were performed.

Materials and Methods

The Niklason et al. (1994) algorithm

$$E = H_u + 0.06(H_{os} - H_u) \quad (4.1)$$

Where: H_u is $H_p(10)$, which is the dose equivalent in soft tissue, 10 mm below the surface of the body

H_{os} is $H_p(0.07)$, which is the dose equivalent in soft tissue, 0.07 mm below the surface of the body

Per ICRP,

$$H_u = 0.01H_{os} \quad (4.2)$$

Therefore, to compute for E using the $H_p(10)$ reading from the Mk2+ EPD, we use the equation,

$$E = H_p(10) + 0.06\left\{\left[\frac{H_p(10)}{0.01}\right] - H_p(10)\right\} \quad (4.3)$$

Results & Discussion

- Dose data from CA

	E (μSv)
mean	4.63
SD	9.35
median	0
range	4.86
3rd quartile	6.94

Results & Discussion

Author (publication year)	No of exams	E (μSv)
Lima (2000)	6	7.1
Padovani & Rodella (2001)	20	2.2
Padovani & Rodella (2001)	20	1.0
Delichas (2003)	27	1.8
Delichas (2003)	45	2.9
Tsapaki (2004)	100	1.8
Goni (2005)	21	1.0
Trianni (2005)	40	0.4
Lange (2006)	103	1.0
This study (2011)	30	4.6

Results & Discussion

- Dose data from PCI

	E (μSv)
mean	2.08
SD	3.35
median	0
range	6.54
3rd quartile	3.47

Results & Discussion

Author (publication year)	No of exams	E (μSv)
Padovani & Rodella (2001)	20	4.4
Delichas (2003)	33	1.0
Efstathopoulos (2003)	20	0.2
Tsapaki (2004)	18	0.3
Goni (2005)	21	1.6
Trianni (2005)	33	0.6
Whitby (2005)	13	1.8
Lange (2006)	48	3.4
Morrish & Goldstone (2008)	-	11.2-17
This study (2011)	10	2.08

Results & Discussion

- Dose data from DSU

	E (μSv)
mean	23
SD	227
median	17
range	69
3rd quartile	32

Results & Discussion

Author (publication year)	No of exams	E (μSv)
Chong (2000)	49	5.9
Perna (2000)	82	2.7
Wittkampf (2000)	375	11.0
Wittkampf (2000)	302	1.3
Wittkampf (2000)	597	0.3
McCormick (2002)	24,480	7.0
Efstathopoulos (2006)	43	0.9
This study (2011)	10	23.0

Results & Discussion

- The average no of procedure performed by an interventional cardiologist for the duration of the study is 2 procedures/day.

- For a total of 288 working days for a cardiologist in a year, performing procedures at a rate of 6/week -- the estimate annual *E* from CA is 1.3 mSv, from PCI is 0.59 mSv, and from DSU is 6.6 mSv.

Conclusion

- The estimated occupational radiation dose levels of interventional cardiologists at the Philippine Heart Center is below the 20 mSv/year occupational radiation dose limit, set by the regulatory body.

- It is important to note that the estimated annual dose for an interventional cardiologist from this study is relatively low because most of the cardiologists were attending the IAEA Training Course for Radiation Protection in Interventional Cardiology and Electrophysiology conducted in Manila within the period of this study.

Recommendation

- The use of the complexity index in grouping interventional cardiology procedures piloted by R. Padovani & G. Bernardi in Udine, Italy should be used for further assessment of dose levels to interventional cardiologists.

- The data can be useful for the regulatory body to investigate further the adequacy of radiation protection and safety practices of workers performing interventional radiology procedures, as well as the implementation of QA program for diagnostic x-ray equipment as required by the regulations.

Thank you for your attention.

Maraming salamat po!