Individual Dose Estimation of the Medical Stuff in Interventional Treatment Using TLD Method

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INTRODUCTION

Interventional radiological procedures are increasingly used for the diagnosis and the treatment in clinical practice (Jankowski, Chruscielewski, Olszenwski, & Cygan, 2002). They have many advantages such as improving the diagnostic quality of examinations and replacing surgery for the treatment. The interventional procedures are faster and cause less traumatic and less complications following the interventional treatment. Patients can also recover soon from interventional procedures. Enormous health benefits are shown from medical uses of interventional radiological procedures and the risks associated with diagnosis and treatment are relatively low. Therefore, they are widely adopted by medical professionals in China (Liu, et al. 2000; Yu, et al. 2005). Interventional radiological procedures become essential tools for improving human health. Patients in China are willing to accept their health care professionals' recommendations for receiving interventional radiological procedures. However, interventional radiological procedures have disadvantages in clinical practice. They can lead to very high radiation doses due to exposure in both patients and medical professionals. According to the United Nations Scientific Committee, the effects of radiation from the diagnostic medical applications of radiation account for about 95% of the exposure to radiation from human-made sources and about 12% of total exposure (International Atomic Energy Agency, 2001).

SUBJECTS AND METHODS

Subjects

The present study included 438 medical professionals from 40 hospitals in Shandong Province, China. Out of 438 medical professionals, there were 185 interventional radiologists and surgeons, 152 radiographic technicians, and 101 nurses who participated in interventional radiology in cardiology, liver, and lung. All of the participants received radiation dose measurements.

Methods

The TLD reader made in the United States and thermoluminescent dosimeters (TLDs) made in China were used in this study. The measurement range of X-ray was within 0.1 mSv and 10 mSv. All 438 participants wore a badge dosimeter, out of which 158 participants wore a ring dosimeter. All the radiation doses were measured to estimate the radiation exposure to the chest and hands of medical professionals, respectively. A badge dosimeter included three units which medical professionals wore in front of their chest area. If medical professionals wore aprons, the TLD was placed in the collar on the left. A ring dosimeter was worn on the thumb of medical professionals. All the medical professionals wore TLDs and ring dosimeters for three months. All the measurements were conducted in the Department of Radiological Protection and Safety, Shandong Center for Disease Control and Prevention, Jinan, Shandong, China. The TLDs were mailed to each hospital before conducting the measurements.

RESULTS

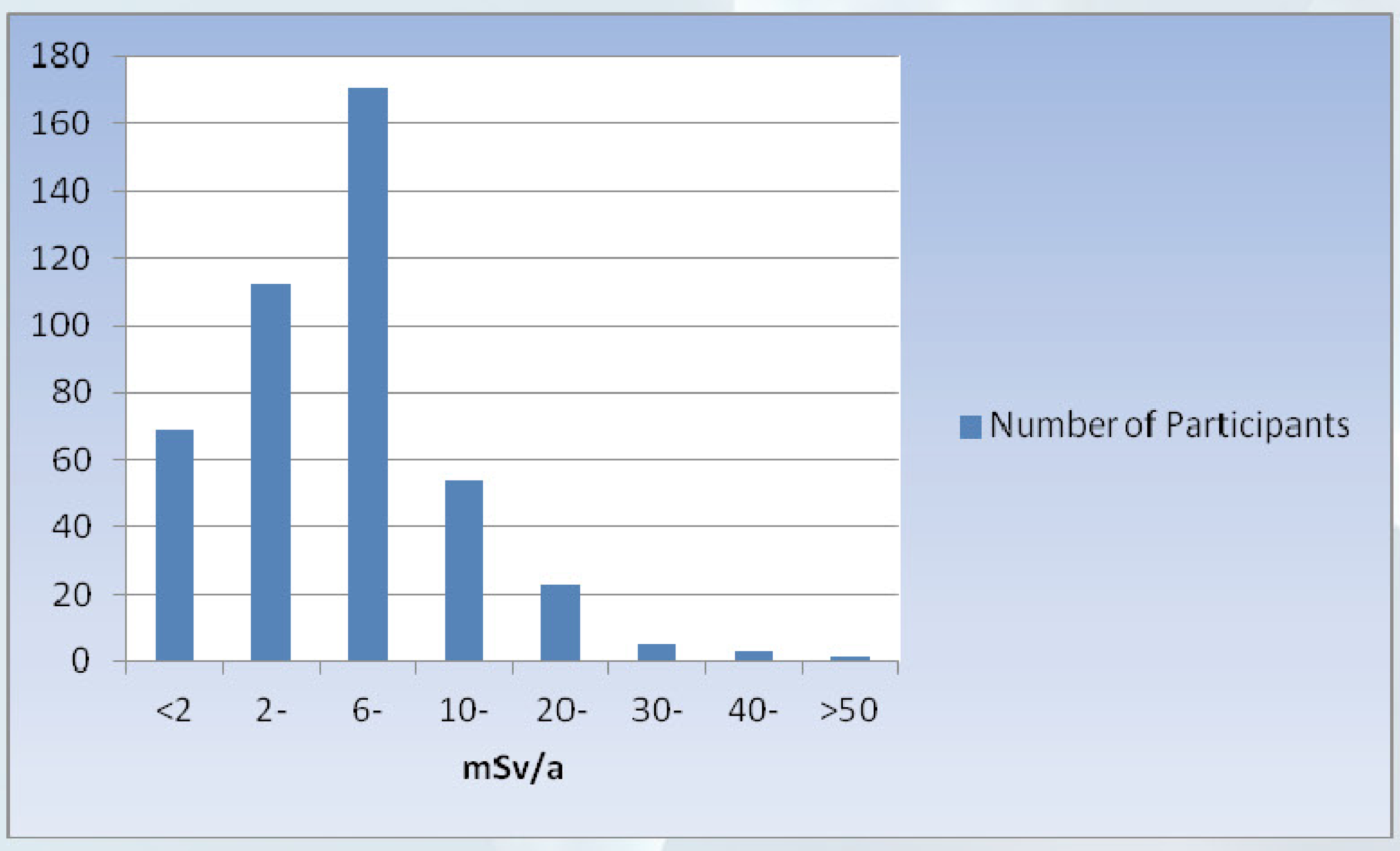
Dose and Dose Distribution to the Chest in 438 Medical Professionals

Table 1. Radiation Doses of the Chest in 438 Medical Professionals (mSv/a)

Occupation	Number of Participants	Annual Exposure Dose	Mean
Interventional Radiologist	185	1.1-52.3	9.4
Radiological Technician	152	0.9-25.6	4.2
Nurse	101	0.9-18.7	3.9
Total	438	0.9-52.3	6.8

The dose distribution to the chest in 438 medical professionals showed that 39% of medical professionals received the average annual dose distribution with the range of 6-10 mSv and 26% of them received the average annual radiation dose at the range of 2-5 mSv. For the detailed results, see Figure 1.

Figure 1. Dose Distribution to the Chest of Medical Professionals (438)



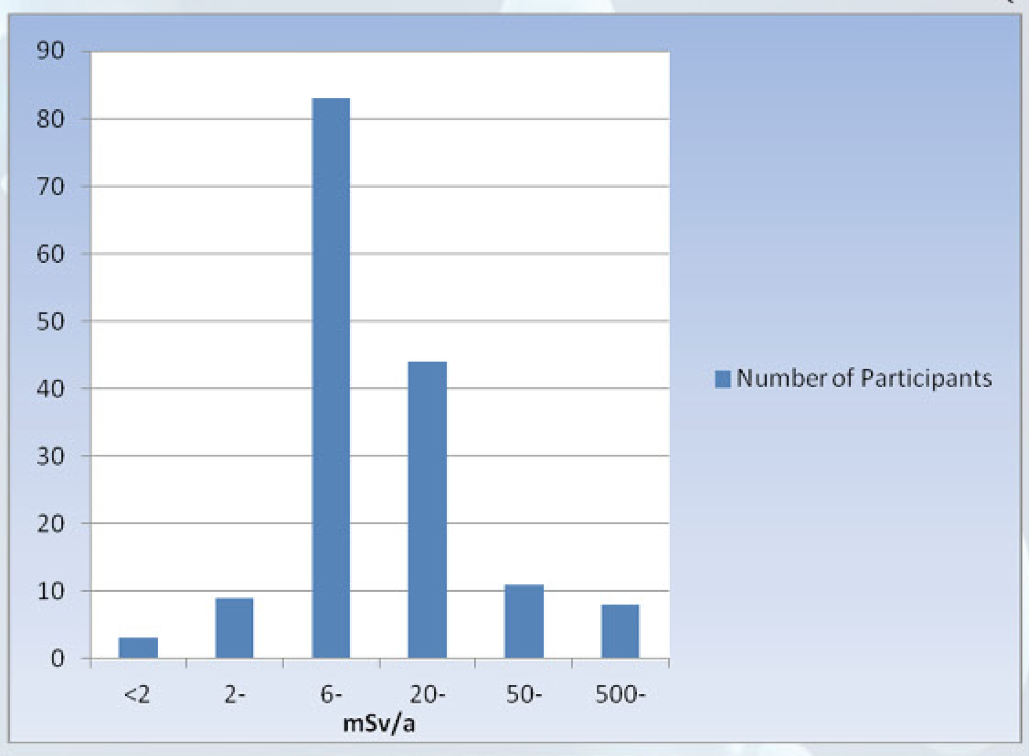
Dose and Dose Distribution to the Hands

Table 2. Radiation Dose in the hands of 158 Medical Professionals (mSv/a)

Occupation	Number of Participants	Annual Radiation Dose	Mean
Interventional Radiologist	95	1.1-227.5	22.4
Radiological Technician	42	0.8-81.9	10.5
Nurse	21	0.2-16.7	5.9
Total	158	0.2-227.5	15.8

For the detailed information on the dose distribution in the hands of medical professionals, see Figure 2 below.

Figure 2. Dose Distribution to the hands of Medical Professionals (158)



DISCUSSIONS

Interventional radiological procedures are performed by interventional radiologists. The present study results showed that the effective dose and dose distribution to the chest and hands of medical professionals were the highest for the interventional radiologists, then radiological technicians, and finally nurses. This study result is consistent with the results in existing studies (Stranden, Widmark, Sekse, 2008). The reasons for this are that interventional radiologists and surgeons are close to the X-ray tube and receive exposure to leaking and scattering radiation when performing interventional procedures. It is recommended that interventional radiologists and surgeons should shorten the operation time and avoid placing hands in radiation beams when performing interventional procedures. Exposure to high doses may be associated with inappropriate equipment, lack of skills in operation, and lack of guidelines of radiation protection.

Therefore, radiation protection of interventional medical professionals in China is a challenge issue. It is difficult to deal with it because interventional radiological procedures have to be performed near a patient's bed. At present, many hospitals in China use a simple additive hanging screen or using lead screen close to the bed. It provides some protection, but it is not an ideal protection measure for most circumstances. In addition, exposure to high doses may be related to the posture of interventional radiologists while performing interventional procedures. Another situation is that interventional radiologists and surgeons are exposed to high radiation from different direction when they perform interventional cardio logical procedures. It is suggested that providing shielding facilities should be encouraged to protect medical professionals from radiation exposure in clinical settings.

CONCLUSIONS

Interventional radiological procedures are widely used for medical diagnosis and the treatment in China. However, much attention to radiological protection of medical professionals must be paid when interventional radiological procedures are performed. The use of appropriate shielding facilities, limiting exposure time of the interventional radiological procedures, and monitoring radiation exposure doses routinely are recommended.

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