

How to Reduce Radiation Exposure to Physicians Performing Fluoroscopy Procedures?

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Introduction

Fluoroscopy procedures refer to a group of procedures which use real-time moving radiological images of patient internal organs and blood vessels. The procedure can be diagnostic, therapeutic, or both. The fluoroscopy procedures have substantially expanded both in scope and in number. Currently various medical specialties, including radiology, neurology, cardiology, electrophysiology, surgery, orthopedics, urology, gastroenterology etc. perform fluoroscopy procedures

One concern of the fluoroscopy procedures is radiation exposure to physicians and thus potential cancer risk. Physicians generally stand close to a patient during a procedure and are exposed radiation scattered from the patient. Physicians perform numbers of procedures during the lifetime and receive cumulative radiation doses.

According to a recent systematic review of occupation radiation dose from cardiac fluoroscopy procedures, physician doses varied by 100-1000 times for the same type of procedure [1]. The large variation in the doses suggests that occupational dose can be greatly reduced by considering what factors and how much these factor influence physician doses from fluoroscopy procedures. The present study identifies and

discusses various factors that affect radiation dose to physicians performing fluoroscopy procedures.

Materials and Methods

Comprehensive and systematic literature review was performed. English-language journal articles and other published data were used to collect occupation radiation dose data. Various factors influencing occupational doses and their degree on dose change were summarized.

Results and Discussion

Many factors related with patient, physician, fluoroscopy system, use of fluoroscopy equipment, and shielding influence radiation dose to physicians. These various factors can change radiation dose with different degree, from a fraction to up to an order of magnitude (Table 1).

Among the various factors, some are uncontrollable. For example, patient and fluoroscopy system can not be modified. Clinical problem of a patient and characteristics of the lesion determine procedure type and its complexity. They are fixed factors. Therefore, physicians can not change the factors to reduce radiation doses. Physician skill level can affect the

time required to carry out a procedure, and thus operator radiation doses. It will takes long time period to change the factors.

Table-1A. Factors influencing radiation dose to physicians performing fluoroscopy procedures (Uncontrollable factors).

| Category | Factors | Degree* |
|---------------------------|-----------------------------|---------|
| Patient | Clinical problem/Complexity | + |
| | Lesion characteristics | + |
| | Body size | + |
| Physician | Height/Gender | + |
| | Experience/Skill | + |
| | Workload | + |
| Fluoroscopy system | Model/Design | + |
| | Dose reduction technology | + |
| Use of fluoroscopy | Tube potential | + |
| | Tube current | + |
| | Beam filtration | + |

* Factors with one plus (+) can change radiation dose to physician by less than 100%, ++ by 2-3 fold, and +++ up to an order of magnitude.

Many factors are under control. Physicians can change procedure techniques and practice by considering fluoroscopy time and dose rates. Most factors related with fluoroscopy equipment operation are modifiable. Therefore, understanding of relationship between these factors and radiation doses are essential to reduce occupational exposure. Shielding is one of the most efficient and easiest methods to protect physicians. Proper and full use of the radiation shields, including personal and movable shields can remarkably reduce radiation dose to physicians.

Conclusions

Many factors with different degrees influence radiation dose to physicians performing fluoroscopy procedures. Many of the factors are under operator's control. Physicians can

immediately change some of these factors and substantially reduce radiation doses and potential harm from the radiation exposure.

Table-1B. Controllable factors

| Category | Factors | Degree |
|---------------------------|------------------------------------|--------|
| Physician | Procedure techniques | + |
| | Position/Pose | + |
| | Awareness of exposure | + |
| Fluoroscopy system | System arrangement | + |
| Use of fluoroscopy | Fluoroscopy time/DAP | ++ |
| | Dose mode | ++ |
| | Pulse rate/Cine frame rate | ++ |
| | Tube/patient/intensifier distances | + |
| | Last image hold | + |
| | Field of view/Magnification | + |
| Shielding | Projection | +++ |
| | Apron | +++ |
| | Thyroid shield | +++ |
| | Goggles | ++ |
| | Gloves | ++ |
| | Ceiling-suspended screen | +++ |
| | Tableside shield | +++ |
| Floor screen | +++ | |

Reference

1. Kim, K. P., Miller, D. L., Balter, S., Kleinerman, R. A., Linet, M. S., Kwon, D. and Simon, S. L. "Occupational radiation doses to operators performing cardiac catheterization procedures" *Health Physics*. 94, 211-227 (2008).