CLINICAL STUDY

Radiation Dose of Nurses during IR Procedures: A Controlled Trial Evaluating Operator Alerts before Nursing Tasks

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ABSTRACT

Purpose: To compare radiation exposure of nurses when performing nursing tasks associated with interventional procedures depending on whether or not the nurses called out to the operator before approaching the patient.

Materials and Methods: In a prospective study, 93 interventional radiology procedures were randomly divided into a call group and a no-call group; there were 50 procedures in the call group and 43 procedures in the no-call group. Two monitoring badges were used to calculate effective dose of nurses. In the call group, the nurse first told the operator she was going to approach the patient each time she was about to do so. In the no-call group, the nurse did not say anything to the operator when she was about to approach the patient.

Results: In all the nursing tasks, the equivalent dose at the umbilical level inside the lead apron was below the detectable limit. The equivalent dose at the sternal level outside the lead apron was 0.16 μSv ± 0.41 per procedure in the call group and 0.51 μSv ± 1.17 per procedure in the no-call group. The effective dose was 0.018 μSv ± 0.04 per procedure in the call group and 0.056 μSv ± 0.129 per procedure in the no-call group. The call group had a significantly lower radiation dose ($P = .034$).

Conclusions: Radiation doses of nurses were lower in the group in which the nurse called to the operator before she approached the patient.

ABBREVIATIONS

H_a = 1-cm dose equivalent at the sternal level on the outside of the lead apron, H_b = 1-cm dose equivalent at the umbilical level inside the lead apron, H_E = effective dose of nonuniform exposure ($H_E = 0.11\ H_a + 0.89\ H_b$)

Komemushi et al (1) prospectively investigated the radiaion dose in nursing tasks associated with interventional radiology procedures, and they reported that the effective dose per procedure was 0.14 μSv. Radiation exposure of nurses in interventional radiology procedures is mainly accounted for by the exposure that occurs when approaching patients during fluoroscopy. If nurses call out to the operator before approaching the patient, the operator can potentially halt the fluoroscopy and reduce unnecessary exposure to nurses. The aim of this study was to compare nurses' exposure when performing nursing tasks associated with interventional radiology procedures depending on whether or not the nurses called out to the operator before approaching the patient.

MATERIALS AND METHODS

This study was approved by the Ethics Committee of the authors' institution. All patients and all nurses provided their written informed consent. All nursing tasks in

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interventional radiology procedures were performed under the management of a radiation protection subchief at the authors' institution who held a First Class Radiation Protection Supervisor qualification. This study was registered with University Hospital Medical Information Clinical Trials Registry (UMIN000012328).

Sample Size

The sample size needed to evaluate radiation dose when comparing the mean values of continuous variables that conformed to a normal distribution in the two groups being tested using Student *t* test, assuming a mean value of $\mu 1 = 0.5$ in the control group, $\mu 2 = 0.1$ in the comparison group, and SD $\sigma = 0.5$, and taking $\alpha = .05$ and power = 80%, was $n = 26$ in the control group and $n = 26$ in the comparison group, for a total sample size of $n = 52$. In our institution, the number of procedures in a typical month is 30, and so the study duration was set at 3 months to ensure a sufficient number of patients, anticipating variation in the number of procedures and protocol divergence. All nurses participating in this study were women.

All nursing tasks during interventional radiology procedures performed in our hospital during the period from March through May 2012 were investigated. Interventional radiology procedures were randomly divided into a call group (in which the nurse called to the operator before approaching the patient) and a no-call group. The randomized allocation sequence was concealed from all nursing staff until interventions were assigned. The random allocation sequence was generated by computer software (Microsoft Excel 2010; Microsoft Japan Co, Ltd, Tokyo, Japan). A.K. enrolled participants and assigned participants to interventions.

Radiation doses during nursing tasks were measured for all nurses engaged in nursing procedures. Radiation doses of operators were also measured. In the call group, the nurse first told the operator she was going to approach the patient each time she was about to do so. In the no-call group, the nurse did not say anything to the operator when she was about to approach the patient. For each interventional radiology procedure, the name of the procedure and the fluoroscopy time were recorded.

When engaged in interventional radiology procedure nursing tasks, the nurses wore radiation protective lead aprons (lead equivalent, 0.25 mm Pb) (LO-S; Hosina Co, Tokyo, Japan). Electronic pocket radiation dosimeters (PDM-117; Aloka Co, Ltd, Tokyo, Japan) were attached at the sternal level on the outside of the radiation protective lead apron and at the umbilical level inside the apron (Fig 1). The parameters of the electronic pocket radiation dosimeters were as follows: energy threshold, 20 keV; detector, silicon solid-state; energy response, 30 keV to 3 MeV within ±30% (calibrated by 40 keV of x-rays using a slab phantom); accuracy, within ±20% (10–9,999 μSv) (calibrated by 40 keV of x-rays using a slab phantom); linearity, within

Figure 1. Radiation dose measurement. Radiation doses were measured using electronic personal dosimeters attached on the outside at the sternal level and inside at the umbilical level of lead aprons. The doses were assessed in terms of equivalent dose penetrating at 10-mm tissue depth outside (H_a) and inside the lead apron (H_b).