The Survey about the Degree of Damage of Radiation-Protective Shields in Operation Room

Jae Sung Ryu, MD, Seung Woo Baek, MD, Cheol Hee Jung, MD, Suk Ju Cho, MD*, Eu Gene Jung, MD, Hae Kyoung Kim, MD, and Jae Hun Kim, MD

Background:
Medical doctors who perform C-arm fluoroscopy-guided procedures are exposed to X-ray radiation. Therefore, radiation-protective shields are recommended to protect these doctors from radiation. For the past several years, these protective shields have sometimes been used without regular inspection. The aim of this study was to investigate the degree of damage to radiation-protective shields in the operating room.

Methods:
This study investigated 98 radiation-protective shields in the operation rooms of Konkuk University Medical Center and Jeju National University Hospital. We examined whether these shields were damaged or not with the unaided eye and by fluoroscopy.

Results:
There were seventy-one aprons and twenty-seven thyroid protectors in the two university hospitals. Fourteen aprons (19.7%) were damaged, whereas no thyroid protectors (0%) were. Of the twenty-six aprons, which have been used since 2005, eleven (42.3%) were damaged. Of the ten aprons, which have been used since 2008, none (0%) was damaged. Of the twenty-three aprons that have been used since 2009, two (8.7%) of them were damaged. Of the eight aprons used since 2010, one (12.3%) was damaged. Of the four aprons used since 2011, none (0%) of them were damaged. The most common site of damage to the radiation-protective shields was at the waist of the aprons (51%).

Conclusions:
As a result, aprons that have been used for a long period of time can have a higher risk of damage. Radiation-protective shields should be inspected regularly and exchanged for new products for the safety of medical workers. (Korean J Pain 2013; 26: 142-147)

Key Words:
fluoroscopy, radiation exposure, radiation-protective shields.
INTRODUCTION

The C-arm fluoroscope is frequently utilized and is absolutely necessary to modern pain medicine [1]. Medical doctors who perform C-arm fluoroscopy-guided procedures are exposed to X-rays. With the continual increase in the worldwide use of X-ray imaging, new challenges arise for the occupational radiation protection of the medical staff [2]. The amount of radiation absorbed by an individual’s tissues corresponds with the risk of developing biologic effects [3]. Such effects are largely divided into two types. The “early effects” correspond to acute radiation lethality, local tissue damage on the skin or gonads, hematologic effects, and cytogenetic effects, while the “late effects” are radiation-induced malignancies, such as leukemia and other forms of cancer, deleterious local tissue effects, chromosomal toxicity, and/or cataract formation [4]. The adverse effects of ionizing radiation on the human body include skin diseases, thyroid cancer, brain tumors, cataracts, and so on [5]. The US FDA reported 26 burn complications due to fluoroscopy between 1992 and 1995 [6]. As a result, radiation-protective methods are recommended to protect medical staff from radiation damages. Radiation-protective shields have different designs: these designs include aprons with front coverage only, aprons that wrap around the body, and two-piece garments with a vest and kilt [7]. Protective garments are wrapped in plain clothes, with the radiation-protective materials inside [8]. Thus, even if there is no damage to the outer portion of the apron, we cannot guarantee the apron’s functionality because there is the possibility that the inner material may be damaged. In general, shields must be used whenever possible to lower the radiation exposure level to a reasonably achievable limit, while not lengthening the fluoroscopy-guided procedure and compromising the patient’s safety [7]. Although radiation-protective shields and thyroid protectors are essential equipment in reducing the radiation exposure of medical doctors who perform interventional procedures, they often have been used for several years without regular inspection. The aim of this study was to investigate the degree of damage to radiation-protective shields in the operating room.

MATERIALS AND METHODS

This study investigated 98 radiation-protective shields (aprons and thyroid protectors) in the operation rooms of Konkuk University Medical Center (KUMC) and Jeju National University Hospital (JNUH). We examined whether these protective shields were externally damaged or not with the naked eye. Also, we checked for any signs of defects, such as holes, cracks, separations and/or pieces which were collapsed down by C-arm fluoroscope. If the radiation-protective shields had cracks or holes, we recorded them and sorted them out by the introduction year at the hospital and location of the damage. For one month, we observed whether doctors and nurses in the operation rooms that use C-arm fluoroscopes dressed in aprons and thyroid shields or not.

We examined the degree to which radiation-protective shields were utilized in each hospital; their utilization by pain clinicians (professors/fellows, residents, and nurses) and surgery personnel was compared with a chi-square test using the SPSS software (version 19.0, SPSS, Inc., USA). Statistical significance was defined as $P < 0.05$. There were seventy-one aprons and twenty-seven thyroid protectors examined for this study. At KUMC, there were fifty-eight aprons and twenty thyroid protectors. At JNUH, there were thirteen aprons and seven thyroid protectors. When examined with the naked eye, there was no apparent damage to the radiation-protective shields. However, defects in the shields were found using fluoroscopy (Fig. 1). Fourteen aprons (19.7%) were damaged, whereas all thyroid shields were normal. The damage to the aprons was classified as holes, cracks, separations, and collapses. Nine holes, seven cracks, five separations, and four collapses were found. Some aprons showed combinations of defects. Of the twenty-six aprons, which have been used since 2005, eleven (42.3%) of them were damaged. Of the ten aprons that have been used since 2008, none (0%) of them were damaged. Of the twenty-three aprons that have been used since 2009, two (8.7%) were damaged. Of the eight aprons that have been used since 2010, one (12.3%) was damaged. Of the four aprons used since 2011, none (0%) of them were damaged. At KUMC, four aprons (6.9%) were damaged, while at JNUH, ten aprons (76.9%) were damaged. The older products, which have been used since 2005, had the highest percentage of damage to the aprons (Table I).