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Assessment of Radiation Protection Devices Practice in Fluoroscopy

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ABSTRACT

Fluoroscopy experts who are exposed to radiation over a prolonged period face a higher likelihood of de veloping cancer caused by radiation. Therefore, the personnel are being more frequently exposed to X ray radiation during their everyday work. This brings up uncertainties about the risks they encounter, and the radiation protection measures required to minimize them.

The objective of the study was to assess the safety measures implemented by theater personnel for radiat ion protection. The survey for the study was conducted on patients and medical professionals involved in fluoroscopic procedures. For the gathering of data, we

observed individuals such as patients, radiation technologists, radiologists, surgeons, and students who w ore radiation protection clothing while undergoing radiological procedures at the Gastroenterology. The total observed individuals were 30 patients and 17 medical professionals.

Fluoroscopy suites are equipped with a variety of shields for personnel, including table skirts, ceiling-suspended shielding, and mobile shields on wheels. These shields decrease scatter radiation from the patient, which constitutes the main source of operator exposure. Leaded aprons and thyroid shields-Fluoroscopy operators and staff need radiation protection garments that fit comfortably and provide adequate protection.

As per the observation result conduction on patients, the thyroid shield was used on 56.7%, on 36.7% gonads shield was used, for reducing the scattering radiation collimators was used in 96.6% of cases and 100% use of filters was seen. The use of lead aprons on the patients was not found as it is basically covering the investing area.

In the observation of medical professionals, only 50% of the radiation technologists used lead gloves, while the lead apron was used by all the medical professionals, only 50% of surgeons used thyroid shielding, and no medical professional was found to use lead googles during the investigation.

As per the survey conclusion all radiation technologists, radiologists, surgeons, and students had good work practice and good knowledge about radiation protection and radiation protection apparel. Instead, they required scheduled training on radiation protection devices and the radiation effects on patients and personnel by different regulatory bodies.

Keywords: Lead Apron, Thyroid Shield, Lead Gloves, Tube Curtain, Collimator, Filters

INTRODUCTION

Fluoroscopy is a medical imaging technique that shows inside organs and tissues moving in real-time on a computer screen by using several pulses, or brief bursts, of an X-ray beam. Fluoroscopy is similar to a video, while standard X-rays are like pictures.

Fluoroscopy is used by medical professionals primarily for two reasons: first, as a diagnostic tool, and second, as a tool for interventional guidance, which helps in the placement of catheters and other treatments including operations.

Early fluoroscopes consisted simply of an X-ray source and a fluorescent screen, between which the patient was placed. After passing through the patient, the remnant beam impinged upon the fluorescent screen and produced a visible glow, which was directly observed by the practitioner.

The fluorescent screen is connected to an electrical device in current systems, which amplifies and converts the brilliant light into a video signal fit for an electronic display. The fact that the fluoroscopist does not have to stand near the fluorescent screen so that you may see the live picture is one advantage of the current method over the previous one. This leads to a significant decrease in the fluoroscope operator's radiation exposure. Additionally, patients receive a lower radiation dose.

Shutters that limit the geometric extent of the X-ray field are present in all X-ray equipment. The X-ray fluoroscopic apparatus, which helps to focus and narrow the primary X-ray beam out of the X-ray tube via an iris-shaped lens most commonly, is also designed using collimation. As a result, less patient tissue is exposed to dispersed radiation, healthcare workers are exposed to less scattered radiation at work, and image quality is enhanced. In fluoroscopy, the collimation may be circular or rectangular in shape, matching the shape of the image receptor.

In 1928, “International Commission on Radiation Protection” (ICRP) was formed. The ICRP is the first standard position body formed, for the purpose of radiological safety. The ICRP issues periodical reports on radiation safety aspects of various applications of ionizing radiation.

Radiation exposure comes from 3 major sources in the fluoroscopic suite, including the primary X-ray beam and leakage and scattered X-ray beams. It must be monitored and should be carried out regularly for both personal safety and regulatory purposes. It should also ensure the safety of patients, staff, personnel, and the public. The Atomic Energy (Radiation Protection) Rules, 2004 (Earlier RPR-1971, Atomic Energy Act, 1962) insists that radiation monitoring is a mandatory one. As per the rule, all radiation workers should be monitored with a suitable radiation-detecting device and use appropriate radiation protection devices.

The main purpose of radiation safety is to protect patients, staff, and the public from unnecessary exposure to ionizing radiation. Radiation safety, also known as Radiological Safety, is the science and practice of protecting people and the environment from the harmful effects of radiation.

Radiation protection can be done by using several protective devices and good work practices.

These devices should include lead apron, thyroid shields, gonad shields, lead gloves, tube curtain/ table drapes, collimator, filters, ceiling mounted barriers, etc. All radiation professionals working in the radiation room must wear radiation protection devices and also provide them to the patients when the X-ray tube is operated.

Lead is the preferred material for radiation-shielding devices. Lead is highly effective in reducing certain variety of radiation because of its high density and high atomic number. It is effective at stopping X-rays

and gamma rays. There are many harmful effects of ionizing radiation on the body, whether it is natural radiation or man-made radiation, whether it is high-dose radiation or low-dose radiation, which affects molecules, cells, tissue, or organs.

AIM & OBJECTIVES

The aim of this study was to evaluate the radiation protection device practice followed in fluoroscopy as described by the regulatory authority and international radiation safety guidance.
The objective of the study is to assess the knowledge of the Radiology technician, surgeon, and students in the utilization of radiation protection devices for the safety of patients and personnel present in the Gastroenterology and Radiology procedure room.

METHOD

Study Design: Prospective study.

Study Area: This study was conducted in the gastroenterology department and radiology department of Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Ambala, Haryana.

Sampling Method:

- Random patient sampling served as the foundation for the study's data collection strategy. The patient and medical professional was observed in the department of gastroenterology and radiology at the Maharishi Markandeshwar Hospital, Ambala with the different procedure done on fluoroscopic equipment.
- For the study the keen observation was basically to look after the uses of radiation protection devices and techniques for reducing the scatter radiation stated by the governing bodies.

Type of Study: Observational prospective study.

Duration of Study: The study was conducted from December 2020 to May 2021.

Sample Size: The total observation was done on 47 individuals which include 30 patients and 17 medical professionals including radiology technologists, radiologists, surgeons, and students.

Inclusion criteria: In this study following category patients were included:

- OPD (outpatients department) patients
- Patients of different age groups.
- Adult patients, those able to wear protective devices

Exclusion criteria: In this study following category patients were excluded:

- Pregnant women
- Patients with psychological illness
- IPD (In patients department) patients
- Pediatrics patients
- Medico-legal cases

- Recent trauma patients
- Uncooperative patients

Technique of study: In this study all patients who were referred for given studies were taken for data analysis.

- Barium swallow
- Barium meal
- Barium enema
- Intravenous Pyelography
- Retrograde Urethrography
- Micturating cysto-urethrography
- Hystero-salpingography
- Endoscopic retrograde cholangiography
- T Tube Cholangiography

Radiation protection devices were provided to all patients during scan and all patients were monitored during and post scanning.

All radiation technologists, radiologists, physicians and students were monitored during the procedure whether they were using radiation protection devices or not.

MATERIALS

Instrument used for the study:

Fluoroscopy unit: Allengers Medical System Limited fixed high frequency fluoroscopic X-ray machines were used for data collection.

- MARS-50 (G-XR-20843)
- MARS-80 (G-XR-23274)

These two fluoroscopic machines models are used for data collection. These machines come with various combinations of examination table and tube stand and application needs for radiation technologists.

Specifications of MARS-50 and MARS-80:

- Model Name and Number- Allengers MARS-50 and MARS-80
- Equipment/Machine type- Fixed
- Machine Frequency- High
- Peak KiloVoltage (kVp) - 125 kVp
- Tube type/Target- Rotating Anode
- Display type- Analog
- Equipment Current- up to 1000mA
- AERB approved- Yes
- MARS-80: 15-LOEE-29451
- MARS-50: 14-RLXE-17178
- Operation mode- Manual
- Generator type- High frequency

- Technology type- Analog
- Country of origin- India
- Tube ratings- MARS-80: 80 KW and MARS-50: 50 KW
- Mode of data collection was based on using a chart table in the Radio-diagnosis department at Maharishi Markandeshwar Hospital, Mullana.
- Data was analysed using descriptive statistical tools, frequency mean and percentage.
- Data collection chart table include patient age, sex, marital status, name of examination performed and equipment used for data collection like lead apron, thyroid shield, gonad shield, lead gloves, filters, collimators etc.
- All patients were monitored during the examination performed.
- Motive of data collection was the use of radiation protective devices.

DATA COLLECTION

The mode of data collection for the given prospective study is by physical visit to the MAHARISHI MARKENDESHWAR HOSPITAL, AMBALA. The motive of the study is to check the awareness and knowledge about the use of radiation protection devices in the fluoroscopy investigation by the radiographic technologist, radiologist, and physicians. The numbers of participants in the study were 47 out of which 30 were patients, 17 were medical professionals which include 4 radiographic technologist, 6 radiologist/physicians and 7 students (interns).

Mode of data collection was based on chart table which includes patient age, sex, name of examination performed and equipment used for data collection like lead apron, thyroid shield, gonad shield, lead gloves, filters, collimator's etc.

All medical professionals were asked about radiation protection and check their knowledge about radiation protection. During the fluoroscopic procedures, the patient, radiation technologists, radiologists / physicians and students were monitored and checked whether they are using radiation protection devices or not. By this manual method data was prepared in the form of chart table.

Demographic profile:

As demographic profile the data analysis for patients was in order such as age group, sex ratio, ratio of investigations, use of thyroid shield, use of gonad shield, use of lead gloves, use of lead goggles, use of tube curtain, use of collimator's, use of filters and use of lead apron for the patient. Similarly, for medical professionals' data analysis order is such as age group, sex ratio, use of lead apron, use of thyroid shields, use of gonad shields, use of lead goggles, use of lead gloves, use of tube curtain, use of collimators and filters during the investigation with appropriate method.

RESULT

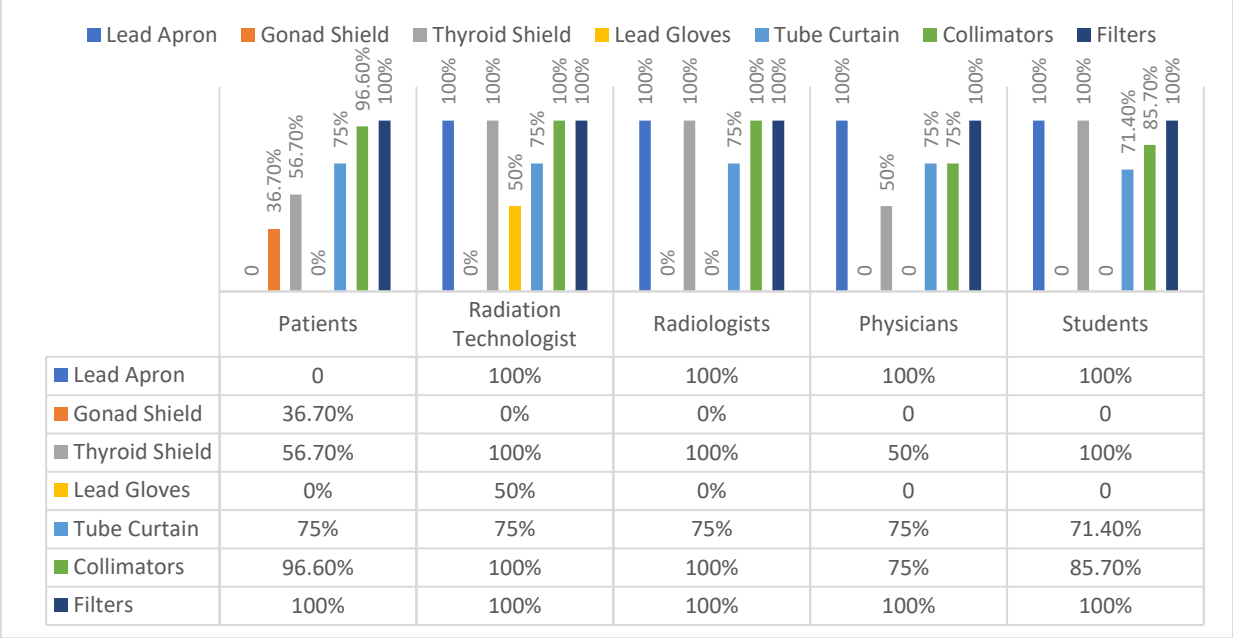
On analyzing the result of different personnel observed in the study, firstly the patients were observed. In this inclusive personnel patients' criteria, the maximum number were belonging to the age group of 26-35 years with equal gender ratios. The use of different radiation protection equipment was observed as; on 56.7% of patient's thyroid shield were used, on 36.7% of patient's gonad shield were used, and in the case of 96.6% patients' collimators were used. Filters use was observed in 100% cases. The use of lead apron on the patients were not observed because it can cover the area of interest for the investigation.

In the second personnel's observation of the medical professional, the categorization was made in the subsequent manner as radiation technologists followed by radiologists, surgeon and the internship students working the investigation room. In the radiation technologists the following observation was found: The 75% were belonging to the age group of 30-40 years, 25% belongs to the age group of 20-30 years with the male female gender distribution ratio as 3:1. The use of lead apron and thyroid shielding were observed by all technologist. While the use of tube curtain in fluoroscopy machine were observed by 75% technologist only. Use of collimators and filters were observed in all cases for the filtration of scatter radiation. Lead gloves and goggles which are also used in the form of a radiation protection device were observed in 50% cases and 0% respectively by the technologist. The graphical representation for the radiation technologist observation of different radiation protection devices is shown:

In the medical professionals, second were radiologist. The observational report of radiologist is: The age groups of 20-30 years (50%) and 30-40 years (50%) were observed in radiologist with the gender ratio as 1:1. The use of lead aprons and thyroid shielding were observed by all radiologist. Similarly, the use of collimators and filters were also found in all cases. While the use of lead goggles and lead gloves were not found among the observed radiologist.

In the medical professionals, the third were physicians. The observational report of physicians is: 50% physicians belonged to the 20-30 years age group and 50% physicians belonged to the 30-40 years age group with male and female ratio as 3:1. The lead apron was used by all physician, while the thyroid shield was used only by 50% physicians. Lead gloves and lead goggles were not used by any of the physicians. The use of collimators and tube curtains were observed only in 75% cases.

In the medical professionals, the fourth or the last included personal was internship students. In their observation report it was analyse that: all the students belong to the age group of 20-30 years with a minority belong to the age group less than 20 years. 57% of students were males and 43% were females. Use of lead apron and thyroid shielding were observed in all cases while the use of lead gloves and lead goggles were not observed in any case. About 71.4% of students used tube curtains during investigations and about 85.7% of students used collimator during investigations.



	Patients	Radiation Technologist	Radiologists	Physicians	Students
Lead Apron	0	100%	100%	100%	100%
Gonad Shield	36.70%	0%	0%	0	0
Thyroid Shield	56.70%	100%	100%	50%	100%
Lead Gloves	0%	50%	0%	0	0
Tube Curtain	75%	75%	75%	75%	71.40%
Collimators	96.60%	100%	100%	75%	85.70%
Filters	100%	100%	100%	100%	100%

Graph: Graphical representation for use of radiation protection devices by medical professionals.

CONCLUSION

Recent years have seen a sharp increase in the use of ionizing radiation in medical imaging for diagnostic and interventional purposes, increasing the risk of radiation exposure for patients and healthcare personnel. Nowadays, dental and medical X-rays are the main man-made sources of radiation exposure. The magnitude of the issue at hand is demonstrated by the documented evidence of low radiation safety knowledge among various cadres of health workers at risk of occupational exposure, despite study reports showing a dramatic rise in the prevalence of adverse health effects following exposure to ionizing radiation over the past 20 years.

The above study was conducted at the Maharishi Markandeshwar University both hospitals Maharishi Markandeshwar Institute of Medical Sciences and Research and Maharishi Markandeshwar Super Specialty Hospital in the department of gastroenterology. The study was followed for the Fluoroscopic procedures done in gastroenterology. Concerns observed in the study were the patients, fluoroscopy operators (technologist), radiologist, physicians or surgeons and the internship students working in the supervision. Radiation hazards increase enormously as the scatter radiation dose increase in effect of which patients and helathcare personnel required radiation protection devices. Radiation exposure can be minimized by wearing proper radiation protection devices like lead apron, thyroid shield, gonad shields, lead gloves, lead goggles, and by using the proper physical barriers like tube curtain, collimators and filters. The total number of patients and medical professionals observed in the study were total 47, out of which 30 were patients and 17 were medical professionals including 4 radiation technologist, 6 radiologist/physicians and 7 were internship students working in the concern department.

On concluded the study conducted on the “Assessment of radiation protection devices practice in fluoroscopy”, the healthcare personnel provide proper radiation protection devices to the patients with minimizing the production of scatter radiation by the use of collimators and filters. In about 56.7% cases thyroid shielding were used on patients, while in 43.3% cases thyroid shield was not used because it was covering the area of interest for the investigation. In 36.7% cases gonad shields was used on patients while in case of 63.3% cases the gonad shield was not because it was obscured the area of interest for the investigation. It was also observed in the case of patient attendants that all were provided proper radiation protection when observed in the radiation field. All radiation technologists were observed using lead aprons, thyroid shield and filters. Radiation technologists used lead gloves in addition with tube curtains and collimators in few examinations because some investigations could not be performed with the use of lead gloves and tube curtains. Lead goggles were not used in any investigation because according to guidelines it was not mandatory to use lead goggles during investigations. All radiologists and physicians used lead aprons, thyroid shields, tube curtain, and collimator during investigations. Radiologists and physicians did not use lead gloves and lead goggles because some investigations could not be performed with lead gloves and lead goggles. The use of tube curtain was not found in around 25% cases because in ERCP investigation it is difficult to perform investigation with endoscope and tube curtain. Lead aprons and thyroid shields were worn by all students during their investigations. Approximately 71.4% of students employed a tube curtain and collimator during the course of their research, while 28.6% did not use them due to incompetence. Because certain experiments could not be conducted using lead gloves and lead goggles, the students did not utilize them.

Findings from the research revealed that medical personnel at MMIMSR had good work habits, was knowledgeable about radiation safety and radiation-resistant clothing, and could offer patients and their companions with suitable radiation protection equipment.

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