Study of Radiation Safety Concerns in Departments of Diagnostic Radiology of various Hospitals of Kashmir valley

M. Mohib-ul Haq, Ph.D.,1 G.M. Mir, M.Sc.,1 Nazir Ahmad Khan, M.D.,2 M. Ashraf Teli, M.D.,2 M. Maqbool Lone, M.D.,2 Fir Afroz, M.D.,2 Shoukat H. Khan, M.D.,2 Tanveer A. Rather, M.D.,2 Aijaz Ahmad Khan, M.Sc.1
Departments of 1Radiological Physics, 2Radiation Oncology, and 3Nuclear Medicine, Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar-190011, Kashmir, India.

ABSTRACT

BACKGROUND: A primary consideration in any radiographic procedure is to reduce the dose to the patient and the operator while still achieving the diagnostic goals.

OBJECTIVE: To study the radiation exposure and protective measures in different units of various hospitals in Kashmir valley in compliance to recommendations from regulatory authorities.

METHODS: Twenty-eight stationary X-ray units of various major hospitals of the Kashmir Valley were surveyed by the radiation safety group of SKIMS. Panoramic survey meter, Thyac-V survey meter-470A, Prima-7 digital survey meters were used for radiation exposure estimations. The radiation level measurements were carried out at different critical locations like control console, door and the corridor adjacent to the Diagnostic equipment and were compared with the standards of AERB and IAEA.

RESULTS: Of the 28 stationary X-Ray units identified 21 were functional and surveyed. Seventy seven Radiation workers (Technicians) operating these units perform about 1335 diagnostic procedures daily on these units. Out of 21 X-ray units surveyed, 9 (42.86%) had dose rate at the control panel within the permissible limits and 12 (57.14%) had exposure levels higher than permissible limits. The dose levels at the door and corridor were exceeding the permissible limits in all the units. Most of the radiation workers had no concept of radiation protective measures and did not use any personal radiation monitoring device like TLD (Thermo-luminescent dosimeter).

CONCLUSIONS: To avoid radiation exposure, the radiation safety measures ought to be strictly followed which is possible by making the concerned authorities answerable and accountable. Also the radiation workers need to be made aware of hazards of radiation exposure, importance of using personnel monitoring devices and providing knowledge about the safety measures. JMS 2010;13(2):51-55

Key words: ICRP, Radiation safety, AERB, IAEA, Personal monitoring, Permissible dose

Radiation protection finds its importance commonly in nuclear reactors, industries and medical science for the safety of both radiation workers and public.1 In medical science, medical X-ray, that is, diagnostic radiology is one of the most used modality for diagnoses, hence, the largest contributor to public exposure to ionizing radiation. About 80% of the dose to the population is estimated to be contributed by medical diagnostic X-ray examinations.2 These examinations not only result in the irradiation of patient but also expose occupational radiation workers to some radiation dose.1 Non occupational personnel like patients, attendants, employees and visitors who are around the radiation departments are also not spared. In this regard, International Commission on Radiation Protection (ICRP) published its recommendations time and again and up to 1991 the recommendations of ICRP-26 were being followed allowing the annual dose limit of 50 mSv/year averaged over a block of 5
In 1991, ICRP-60 was published wherein the dose limits were reduced to 20 mSv/year averaged over five year block with further provision that effective dose should not exceed 50 mSv in a single year, however, AERB recommended that the maximum effective dose in a single year should not exceed 30 mSv. Recently in 2007, ICRP - 103 was published wherein the annual limits were unchanged, however, tissue weighting factor of some organs and radiation weighting factor of neutron were changed.46

In India more than 50,000 X-ray units are operational and another 1000 are added every year.64 The AERB of India is the national regulatory body and the competent authority for enforcing regulatory provisions for radiation protection in India.9 The AERB is responsible for laying down the national safety codes and standards that stipulate the requirements for safe handling of radiation sources, including medical diagnostic X-ray installations.43 The safety code published by AERB in 200115 is intended to govern radiation safety in design, installation and operation of X-ray equipment for diagnostic purposes. The implementation of these codes ensures the protection from radiation of occupational workers, patients and public.

In the present paper, we have studied radiation safety concerns in Diagnostic radiology departments of various hospitals of Kashmir valley. An important aspect of the study was to perform the inter-comparison of the radiation safety measures in these hospitals and also with respect to the national standards. The work practice, radiation awareness and work load, which play vital role in the safety measures, were also studied briefly. Suitable exposure parameters like collimation precision, use of optical beams, implementation of Quality assurance (QA) tests etc. was also taken into consideration in the present study.

Material and Methods

The radiation safety group of the Department of Radiological Physics, SKIMS is facilitated with a well equipped radiation safety laboratory. The stationary radio-diagnostic units of 12 major hospitals; both in private and government sector, of the Kashmir valley were selected for the survey. There were 28 stationary and 14 portable X-ray machines in these hospitals. However, this study was restricted to the stationary X-ray units only because portable machines are used for emergency cases without any concrete/protective housing. Moreover, out of 28 stationary units only 21 were surveyed, rest 7 were non-functional at the time of study. Radiation level measurements were performed at the three selected locations as per the standard protocol, that is, at control panel, at door of the x-ray room and in the corridor adjacent to the x-ray room. The measurements were carried out by using three radiation survey meters (Table 1). Since GM tube based survey meters have the high exposure rate limitations, that is, beyond the exposure rate of 1000 mR/hr, the survey meter shows zero reading, hence the measurements were also done with the ionization chamber based survey meter (Table 1).

Results and Discussion

The hospital wise details of the equipment, the number of radiation workers, daily work load and availability of personal monitoring service are presented in Table 2. It was observed that...
about seventy seven radiation workers perform a minimum of one thousand three hundred and thirty five X-ray procedures daily. Also, the personal monitoring service was provided in three hospitals only, that is, Sher-i-Kashmir Institute of Medical Sciences Soura, Srinagar, SKIMS Medical College, Bemina, Srinagar, and Khyber Medical Institute, Srinagar. In the remaining hospitals neither the personal monitoring devices were used nor did the workers have the concept/insight of personal monitoring and radiation safety. During the study it has been also observed that out of 77 workers, only 19 have the diploma in radiography which is essential qualification laid down by AERB. Rest were selected on the basis of experience of which 13 were simple matrix, which is a clear violation of AERB guidelines. Further, among the radiation workers who availed the radiation monitoring service, about 31(40.25%) had poor compliance in using and changing TLD’s on a regular basis. The reasons for this poor compliance were carelessness and lack of radiation safety awareness among the radiation workers coupled with lenience by the regulatory authorities. Moreover, it was observed that the work practices during the radiation procedures were not satisfactory. Attendants were allowed to stay around the X-ray machine unnecessarily during the exposures, doors were kept open, collimators were kept wide open and in several instances the light beam devices were non-functional. Moreover, it was observed that there were no working signs like red lights, ionizing radiation symbols etc., in any of the hospitals surveyed.

Accuracy, quality control status and other relevant technical details are given in Table 3. It is evident from the Table 3, that some machines were very old. The parameters and scales on these machines were not prominent enough and were adjusted on hit and trial basis, resulting in repetition of the procedure. Consequently, leading to an increase in dose to both patient and radiation worker. It was also observed that except the machines installed in one of the hospitals (Hospital No. 1), no QA/QC tests had been conducted on these machines, that is, neither at the time of commissioning nor afterwards at the time of breakdown or servicing.

To find if the radiation level at various places occupied by the radiation workers and public in the vicinity of X-ray machine was under safe limits, the radiation dose was measured at control panel, door of the X-ray room and corridor adjacent to the X-ray room. All the measurements were carried out during the conduct of X-ray procedure, that is, in presence of patient so that scatter is also taken into consideration. Moreover, the survey at all the centers was done for chest X-ray procedures with KVp = 60, and mA = 30 (mA = 60 and s = 0.5). It may be recalled here that the permissible dose at the control panel is 20 mSv/year (radiation workers dose limit). Similarly, the permissible dose at the door of the x-ray room and corridor adjacent to the x-ray room is 1.0 mSv/year (public dose limit). Our results of the exposure measurements at different locations is shown in Table 4.

Comparing our results with the permissible dose limits (Table 4), it was observed that out of 21 units of X-ray machines surveyed, 9 units (42.86%) had the dose rate at the control panel well within the permissible limits. While as the remaining 12 (57.14%) machines had dose rate at control console above the permissible limits. Comparing the dose rates at the door and the corridor areas, it was observed that the exposure levels in all the cases were higher than the permissible limits. However, in some cases the observed level was exceeding the permissible limit by a small margin, that is, 1(4.8%) of machines (Hospital No. 3, machine no. d) had the observed dose at door ≤ 5 mSv/year. The reason for this may be the contribution of background radiation,
which is 3.0 mSv/year. Similarly, in the adjacent corridor, 3(14.29%) machines had the observed dose ≤ 5 mSv /year.

Further, of the machines studied, 20(95.2%) had the observed dose at door >5 mSv /year and18(85.71%) had the observed dose in adjacent corridor >5 mSv /year. This is due to the faulty design of layout housing, wherein no radiation safety aspects had been taken into consideration during the construction of these X-ray laboratories or due to bad work practice where the radiation workers are careless regarding the radiation safety concerns. In Table 4, non- permissible dose limits are represented by NP. In this regard necessary action needs to be initiated by the authorities to bring the levels within the permissible limits.

Conclusions

Most of the occupational radiation workers of Diagnostic radiology departments of various hospitals of Kashmir valley are lacking the facility of personal monitoring. These radiation workers must be registered for personnel monitoring so as to monitor their cumulative exposure and evaluate any radiation related short term/long term stochastic/non-stochastic effects.

The QA tests must be carried out on regular basis and every machine must be operated by well qualified and trained staff so that the radiation safety principles are strictly followed.

Since, the number of radio-diagnostic facilities is constantly increasing; it becomes very essential to have a centralized laboratory in all the centers to monitor the radiation hazards, for its employees in particular and the public in general. The concerned personnel in these centralized laboratories may help in the implementation of judicious combination of Time, Distance and Shielding, which in turn will help in attenuation and minimization of levels of radiation exposure, thereby, bringing the safety aspects very close to the rule of ALARA. For this purpose all the X-ray machines of the state must be brought under the supervision of a single authority so that a common registry regarding the procurement, maintenance and condemnation is maintained along with the regular surveys of radiation departments and compliance with national regulatory body.

References

8. Sonawane AU, Singh M, SunilKumar JVK, Kulkarni A, Shirva VK, Pradhan AS. Radiological safety status and
quality assurance audit of medical X-ray diagnostic installations in India. *Journal of Medical Physics* 2010;35:4: 229-34.


